SIEMENS

SONOLINE G60 S Ultrasound Imaging System
[2] Instructions for Use

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SONOLINE G60 S
Ultrasound Imaging System
[2] Instructions for Use

Software Version 10

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CE Declaration

For systems affixed with a CE mark: This product is provided with a
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93/42/EEC of June 14, 1993 concerning Medical Devices. Siemens Medical
Solutions USA, Inc., is certified by Notified Body 0123 to Annex II.3 – Full
Quality System.

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Siemens reserves the right to change system specifications at any time.

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Note: Not all features and options described in this publication are available to all users. Please check with your Siemens representative to determine the current availability of features and options.

About This Manual

The Instructions for Use consists of two volumes:

- [1] Instructions for Use

The *[1] Instructions for Use* includes both a general overview and a technical description of the ultrasound imaging system. This manual contains detailed information on the safety and care of the ultrasound system and its transducers. A chapter is dedicated to the description of all system controls. The *[1] Instructions for Use* also includes the procedures for system setup and beginning an exam.

- [2] Instructions for Use

The *[2] Instructions for Use* includes procedures for acquiring and optimizing images. This manual provides procedures for general and exam-specific measurements and calculations.

The *System Reference* provides reference information for the ultrasound imaging system.

The *Electromagnetic Emissions and Immunity: Guidance and Manufacturer's Declaration* publication provides information regarding the electromagnetic compatibility (EMC) testing of this system.

Conventions

Conventions used throughout this manual are listed below. Take a moment to familiarize yourself with these conventions.

Cross-References

This manual provides you information by topic. When additional information exists within this or other manuals, a reference graphic and the name of the book is provided in the right column. If the information exists within the chapter, a cross-reference to the page number is listed. Otherwise, information is referenced by chapter number.

System Presets

You can use the options and settings available in the system presets menu to set up the ultrasound system with your preferences. Presets define the configuration of the system software whenever you power on the system.

A complete listing of system presets is located in the *System Reference*. Whenever a system preset is discussed in other chapters or in the User and Reference Manuals, a graphic is provided in the right column.

The graphic identifies a preset option or setting in the system presets menu that is available for you to customize your ultrasound system. The name of the category on the menu containing the system preset is listed for your convenience.

Warnings, Cautions, and Notes

⚠ **WARNING:** Warnings are intended to alert you to the importance of following the correct operating procedures where risk of injury to the patient or system user exists.

⚠ **Caution:** Cautions are intended to alert you to the importance of following correct operating procedures to prevent the risk of damage to the system.

Note: Notes contain information concerning the proper use of the system and/or correct execution of a procedure.

Control Panel Keys, Controls, and LCD Selections

Keys and controls located on the control panel are identified by uppercase, boldface type.

> *Example:* Rotate the **ZOOM** control.

Function keys located on the keyboard are identified by the number of the function key.

> *Example:* Press the **F4** key.

LCD keys are indicated by a (**O**) symbol with the name of the selection in boldface type.

> *Example:* Press **ONext** to access the second page of LCD selections.

Selection of On-Screen Objects

The **SET** key on the control panel functions as a point-and-select device (similar to a computer mouse) when used with the trackball. To select an on-screen object such as a button or a ▼ symbol, roll the trackball to position the pointer (cursor) on the object and then press the **SET** key on the control panel.

In this manual, the term "select" or "click" describe the trackball and **SET** key action required to select an on-screen object. In the example below, phrases A, B, C, and D are equivalent actions.

A. Roll the trackball to the **Search** button and then press the **SET** key.

B. Select the **Search** button.

C. Click the **Search** button.

D. Click **Search**.

Special Terms and Menu Options

Special terms are indicated in boldface italics and are accompanied by a brief description on their first use in the manual.

Example: Provides on-screen anatomical graphics of ***pictograms*** that indicate the anatomy under evaluation.

Within a procedure, options in the system presets are identified in text as boldface type.

Example: Highlight the **Keyboard – Annotation** option.

A1 Imaging Functions

Annotation

You can use four methods to annotate an image:

- Direct text entry using the keyboard
- Predefined labels for positions and anatomical structures
- Pictograms of anatomical structures
- Arrow keys

To remove annotation from the image screen, use the **F11** key. You can program the system to automatically delete on-screen annotation each time you use the **FREEZE** key to unfreeze the image. Use the system presets to specify whether all text or all pictograms are deleted at unfreeze.

The default position for the annotation cursor on the image screen is in the location defined by the **F9** key.

Once you have annotated an image during a patient examination, the system remembers the last position of the cursor; press the **SELECT** control to redisplay the annotation cursor.

To reposition an annotation:

1. During the annotation function, roll the trackball to position the cursor on the text, label, or arrow.

2. Press the **SET** key to select the annotation.

3. Roll the trackball to reposition the annotation and then press the **SET** key.

To delete a single annotation:

1. During the annotation function, roll the trackball to position the cursor on the text, label, or arrow.

2. Press the **SET** key to select the annotation.

3. Press the **Delete** key, the **F10** key, or the **F11** key on the keyboard.

System Reference

▤

F4

General
▶ Delete Text
  on Unfreeze
General
▶ Delete Pictogram
  on Unfreeze

Direct Text Entry

Use the keyboard to enter text directly onto the image area.

Use the system presets to specify the default size of the annotation text and to automatically display the text entry cursor when you freeze the image.

To activate text entry:

1. Press the **TEXT** key on the control panel or the **F12** key on the keyboard.

    The system places the text cursor on the image screen.

2. To reposition the text cursor, roll the trackball.

3. To change the size of the next text entry, rotate the **SELECT-L** or the **SELECT-R** control on the LCD panel.

4. Use the keyboard to enter text.

5. To exit the text entry function, press the **F12** key on the keyboard or the **TEXT** key on the control panel. To exit the text entry function and delete all text, press the **ESC** key on the control panel.

Labels for Position and Anatomical Structures

Each exam type has labels for anatomical structures, imaging views, and body positions that can display as LCD selections when the exam type is active. The labels are stored in libraries. Use the system presets to customize the text for anatomical structures, for imaging views, and for body positions. You can:

▪ Add, replace, or delete labels from the LCD

▪ Change the spelling or abbreviation of the labels

▪ Establish the order in which the labels display on the LCD

▪ Reset the library to the original system-defined labels

Use the system presets to specify the default size of the annotation text and to automatically display the text entry cursor when you freeze the image.

To annotate using a predefined label:

1. Press the **TEXT** key on the control panel or the **F12** key on the keyboard.

2. Rotate the **FUNCTION SELECT** control on the LCD panel to select the type of label. Highlight the **Ana** tab for Anatomy or the **Pos** tab for Position.

   The system places the text cursor on-screen and displays the LCD selections of labels for the active exam. To view additional LCD selections, push the **PAGE** control.

3. To reposition the text cursor, roll the trackball.

4. To change the size of the annotation text, rotate the **SELECT-L** or the **SELECT-R** control on the LCD panel.

5. Select the LCD key for the required label and then press the **SET** key.

   Note: Some LCD cells display two labels for selection. To display the second label located at the bottom of the cell, you must press the associated LCD key two times.

   The system inserts the label at the cursor.

6. For each additional label, position the cursor again with the trackball, select another label with an LCD key, and press the **SET** key.

   Note: You can place a combined total of 24 labels and arrows on the image screen.

7. To delete the last label from the screen, press the **F10** (Delete Line) key on the keyboard. Each press of the **F10** key deletes the next most recent label. To delete all annotations from the screen, press the **F11** (Delete Text) key.

8. Press the **TEXT** key on the control panel or the **F12** key on the keyboard to exit annotation. Press the **ESC** key to exit and delete the labels.

Directional Arrows

You can place arrows on-screen by first pressing the **TEXT** key on the control panel or the **F12** key on the keyboard and then pressing the **⭕Arrow** LCD key.

Use the system presets to specify the default size of annotation arrows.

To place an arrow on the image screen:

1. Press the **TEXT** key or the **F12** key.

   The system displays the text cursor as a vertical bar.

2. Roll the trackball to position the cursor at the required location for the arrow.

   Note: If you are adding an arrow immediately after entering text or a label, roll the trackball away from the text before adding the arrow.

3. Press **⭕Arrow** from either the **Ana** tab or the **Pos** tab LCD page.

   The arrow displays on the image at the text cursor.

   Note: You can place a combined total of 24 labels and arrows on the image screen.

4. To change the direction of the arrow, rotate the **SELECT** control on the control panel.

5. To change the size of the arrow, rotate the **SELECT-L** or the **SELECT-R** control on the LCD panel.

6. Roll the trackball to reposition the arrow on the image and then press the **SET** key.

7. To delete an arrow, press the **F10** (Delete Line) key.

8. To exit the arrow function and retain all the arrows and labels, press the **F12** key on the keyboard or the **TEXT** key on the control panel. To exit the arrow function and erase all arrows and labels, press the **ESC** key.

System Reference

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▤
F4

General
▶Arrow Size

Pictograms

Pictograms are graphics that display on-screen to indicate the anatomical structure under evaluation and to indicate the orientation of the transducer to the structure. You can rotate fetal pictograms to indicate the orientation of the fetus in utero.

Use the system presets to automatically display pictograms when you freeze the image.

Use the system presets to assign pictograms to LCD keys for each exam type. When the exam is active, pressing the **PICTOGRAM** key causes the assigned pictograms to display as LCD selections. One pictogram can display on an image. In Dual-mode and 4B-mode, you can display one pictogram for each image.

The selected pictogram for an image will display until you press the **ESC** key, select a new pictogram, or begin a new exam. Use the system presets to automatically remove a pictogram when you unfreeze an image.

To display a pictogram:

1. Press the **PICTOGRAM** key.

   The LCD displays the available pictograms for the active exam type.

2. Push the **PAGE** control to access additional LCD pages.

3. Press the LCD key for the required pictogram.

   The selected pictogram displays with a transducer orientation indicator in the lower left of the image.

4. Roll the trackball to position the transducer orientation indicator.

   a. To rotate the indicator, rotate the **SELECT** control.

   b. To anchor the position of the indicator, press the **SET** key.

System Reference

System Presets   Ch 3

F4

Default Settings
▶ Pictogram List
▶ Automatic Freeze
   response
General
▶ Delete Pictogram
   on Unfreeze

QuickSet Feature

The QuickSet feature allows you to capture an optimized configuration of imaging parameter settings for a specific transducer and exam. The system stores this configuration in a file known as a ***QuickSet***.

When a QuickSet is selected as the current exam type, the system activates the associated transducer and resets all imaging functions according to the stored configuration.

Use the system presets to change the default settings for an existing QuickSet.

Creating a QuickSet

You can have a maximum of 32 QuickSets on the system at one time. If you attempt to create a new QuickSet, or load a saved QuickSet from disk after the maximum of 32 is reached, the system requires you to delete one or more existing QuickSets to accommodate the new ones.

To create a QuickSet:

1. Adjust the image parameter settings as required and then press the **F8** function key on the keyboard.

   The system displays a screen for saving and deleting QuickSets.

2. Roll the trackball to the **QuickSet Name** field and then press the **SET** key.

3. Use the keyboard to enter up to 20 characters for the name of the QuickSet.

4. Save the name by either rolling the trackball to the **Save** button and pressing the **SET** key or by pressing the **ENTER** key on the keyboard.

   The system displays the image screen and activates the QuickSet you created.

To overwrite an existing QuickSet with the current image parameter settings:

1. Adjust the image parameter settings as required and then press the **F8** function key.

    The system displays a screen for saving and deleting QuickSets.

2. Roll the trackball to an existing QuickSet and then press the **SET** key.

3. Roll the trackball to the **Save** button and then press the **SET** key.

    The system displays a message asking if you want to overwrite the QuickSet.

4. Roll the trackball to the **OK** button and then press the **SET** key to assign the new QuickSet configuration to the existing name.

To delete an existing QuickSet:

1. Press the **F8** function key.

    The system displays a screen for saving and deleting QuickSets.

2. Roll the trackball to an existing QuickSet and then press the **SET** key on the control panel.

3. Roll the trackball to the **Delete** button and then press the **SET** key on the control panel.

    The system removes the highlighted name from the list of QuickSets. If you attempt to delete a QuickSet when it is the current exam type, the system displays a message stating that you cannot delete a QuickSet currently loaded on the system.

Activating a QuickSet

A QuickSet is a user-defined variation on a system-defined exam type. To select a QuickSet exam type, use one of these methods to access the **Exam & QuickSet List**:

- Press the **F5** function key

- Press the **EXAM** key on the control panel

- Roll the trackball to the **EXAM** button on the **New Patient Data** or **Patient Data** form and then press the **SET** key

From the **Exam & QuickSet List**, roll the trackball to the QuickSet and then press the **SET** key on the control panel.

Note: When a QuickSet is selected as the current exam type, the system activates the associated transducer and resets all imaging functions according to the stored configuration.

2D-Mode and M-Mode QuickSets

A QuickSet includes the following 2D-mode and M-mode parameters:

2D-mode	M-mode
▪ Gain	▪ Sweep Rate
▪ Persistence	▪ Dynamic Range
▪ Gray Map	▪ Edge Enhancement
▪ Dynamic Range	▪ Reject
▪ Edge Enhancement	▪ 2D-Color Map
▪ 2D-Color Map	▪ Gain
▪ Field of View (linear, curved array, and phased array transducers)	▪ Gray Map
▪ Transmit Power	▪ Transmit Power
▪ Depth (mm)	
▪ Line Density	
▪ Focal Zones	
▪ Initial Frequency (MHz)	
▪ Rotate	
▪ Flip (L/R)	
▪ Reject	
▪ Res/Speed	
▪ Scan Angle (Endo-V II transducer)	
▪ TGO settings	

Color Flow QuickSets

A QuickSet includes the following Color parameters:

- Color Map
- Baseline
- Flow Stages (**H, HM, M, ML, L**)
- Initial Transmit Frequency
- Persistence
- Density
- Temporal Averaging
- Noise Cut
- Gain
- PSP/QSP
- Peak
- Motion Cut
- Color Priority

Note: A QuickSet saves imaging parameter settings in effect at the time of storage. Each Flow Stage selection controls the settings for Color Priority, Persistence, Density, Motion Cut, Noise Cut, and Temporal. If you select a new Flow Stage and do not subsequently change any of these settings, the Flow Stage and its related settings will be stored as part of the QuickSet. If you change Flow Stage-controlled settings after selecting a Flow Stage, the Flow Stage and its amended, related settings will be stored as part of the QuickSet.

Power Mode QuickSets

A QuickSet includes the following Power parameters:

- Initial frequency
- Range
- Flash
- Motion cut
- Persistence
- Invert
- Temporal
- Density
- Flow stage
- Power map
- Noise cut
- Color Priority

Note: A QuickSet saves imaging parameter settings in effect at the time of storage. Each Flow Stage selection controls the settings for Color Priority, Persistence, Density, Motion Cut, Noise Cut, Flash, and Temporal. If you select a new Flow Stage and do not subsequently change any of these settings, the Flow Stage and its related settings will be stored as part of the QuickSet. If you change Flow Stage-controlled settings after selecting a Flow Stage, the Flow Stage and its amended, related settings will be stored as part of the QuickSet.

Doppler QuickSets

A QuickSet includes the following SCW and PW Doppler parameters:

- Trace Mode
- Trace Mean
- Trace Min
- Trace Max
- Filter
- Color
- Sweep Speed
- Reject
- 2D Update
- Doppler Gain
- Gate Depth

- Audio Balance
- Pre Process
- Post Process
- Scale
- Flow Angle
- Transducer Frequency
- Gate Size (none with SCW Doppler)
- Baseline
- PRF
- Focus

A2 2D-Mode and M-Mode Imaging Functions

Activating 2D-Mode

2D-mode is the default imaging mode for the ultrasound system.
2D indicates two-dimensional (2D) grayscale imaging. When you first
power on the system, 2D-mode is active, and the 2D tab is highlighted.

To access 2D-mode from another imaging mode:

- Press the **2D** control on the control panel.

  The system displays in 2D-mode (full screen).

Note: When operating in mixed modes (for example, 2D-mode with M-mode, 2D-mode
with Doppler, or 2D-mode with Color), pressing the **2D** control deactivates M-mode,
Doppler, or Color and displays full-screen 2D-mode imaging.

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2D-Mode Formats

You can display 2D-mode images in different formats: Split, Dual and
4B modes. Imaging capability in 2D-mode, M-mode, A-mode, and mixed
modes is available. The following mixed mode formats are available:

- 2D/M-mode
- 2D/Doppler
- 2D-mode with color
- 2D-mode with power
- 2D/M-mode with color
- 2D/Doppler with color
- 2D/Doppler with power

Active Image

In Split, Dual, and 4B modes, while more than one 2D-mode image displays
on the monitor, you can adjust imaging parameters for one image at a time.
This image is the **active** image. The system indicates the active image with
the active image indicator.

Active image indicator.

Inactive image indicator.
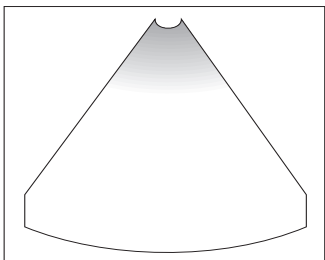
Standard 2D-mode.
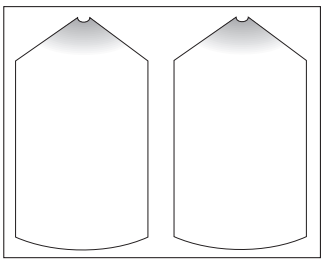
Dual-mode.
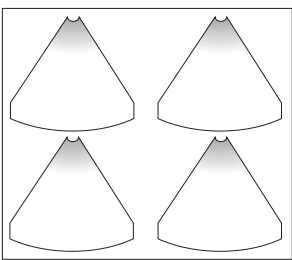
4B-mode.
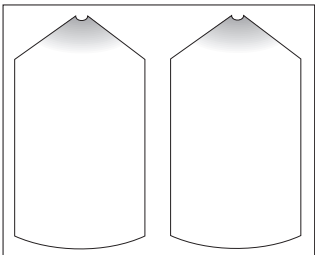
Split (B+B) mode.
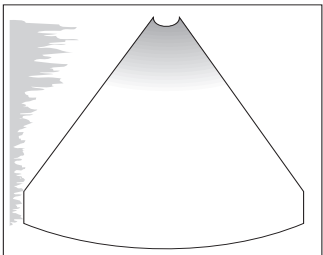
2D-mode with A-mode.

Activating Split Mode

Split mode creates side-by-side images from one 2D-mode image. The two images are simultaneously frozen or real-time. Split mode is available with all transducers.

When you first initiate Split mode, the image parameter settings from the previous mode are applied to both images. Certain imaging parameters (such as Color, Gray Map, A-mode, Reject, and Modify Map) can be changed in the right image, allowing comparison of the effects of different image settings on an anatomical structure.

To activate Split mode:

1. From a 2D-mode image display, press the **SPLIT** key on the control panel.

    The left image is the reference image.

2. To display the full-screen 2D-mode image, press the **SPLIT** key or the **2D** control on the control panel.

3. To simultaneously freeze both images, press the **FREEZE** key on the control panel.

4. To exit Split mode, press the **2D** control.

Activating Dual-Mode

In Dual-mode, two acquired 2D-mode images display side-by-side on the image screen. Both images are obtained separately, and only one image displays in real-time.

When you first activate Dual-mode, the imaging settings from the previous mode are applied to the first image. The second image retains the same settings as the first image.

You cannot activate M-mode while Dual-mode is active. You cannot activate Dual-mode while 2D/M-mode is active.

To activate Dual-mode:

1. Press the left **DUAL/SELECT** key on the control panel to display an image on the left side of the screen, or press the right key to display an image on the right side of the screen.

    Only one image can be active at a time. The active image is indicated by the lighting intensity of the selected key and by the active image indicator.

2. To generate a second image, press the other **DUAL/SELECT** key.

    The system freezes the active image and activates a second image.

3. To display a full screen image, press the key for the active image a second time. Press the key again to restore the side-by-side display.

4. To inactivate the current image and activate the other image in a side-by-side display, press the **DUAL/SELECT** key.

    The system shifts the active image indicator to the selected image and freezes both images.

5. Press the **FREEZE** key to unfreeze the Dual-mode display.

6. To exit Dual-mode, press the **2D** control on the control panel.

Activating 4B-Mode

In 4B-mode, four separately acquired 2D-mode images display on the image screen. Only one image can display in real-time.

When you first activate 4B-mode, the imaging settings from the previous mode are applied to the first image. Subsequent images retain the same settings as the previous image.

To activate 4B-mode:

1. From a 2D-mode display, press the **4B** key on the control panel.

   The first image displays in the upper left quadrant of the screen. This is the active image, as identified by the brightened active image indicator.

2. Press the **FREEZE** key.

   The image is frozen in position and a second image displays in the next available quadrant.

3. To continue to place images, press the **FREEZE** key.

4. To cycle through the images, first freeze the active image and then press the **4B** key. To display the active image in real-time, unfreeze the system.

5. To exit 4B-mode, press the **2D** control.

Activating A-Mode

Important: At the time of publication, A-mode was not cleared for use by the U.S. Food and Drug Administration. Before using A-mode, check the current regulations for the country in which you are using this system to determine if A-mode is cleared for use.

A-mode is available in 2D-mode. A-mode displays in real-time or displays on a frozen image.

Once activated, A-mode displays even when you change modes. If you enter into a mode that does not support A-mode, the A-mode display is removed. When you activate a mode that does support A-mode, the display and cursor return.

To display A-mode:

1. Press **OA-mode** on the 2D-mode LCD when 2D-mode is active.

   The system displays the **On** setting and places an A-mode cursor in the image area. The location of the cursor designates the region of sampling.

2. Roll the trackball to position the cursor in the image.

   The echo amplitude displays along the depth scale on the image.

3. To remove A-mode from the image, press **OA-mode** until the **Off** setting displays.

Activating M-Mode

When you first activate M-mode, the M-mode cursor displays on the 2D-mode image. This cursor is a graphical representation of the acoustic line along which the M-mode information is gathered. The cursor displays as a row of dots representing depth.

Simultaneous Format

During 2D/M-mode, the 2D-mode image and M sweep display simultaneously in real-time or are simultaneously frozen.

M-Mode Formats

Use the system presets to select your preference of a 2D/M-mode imaging format.
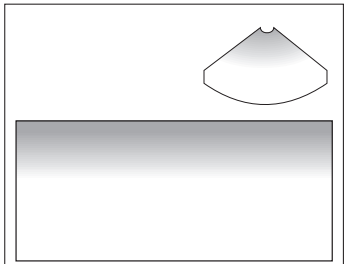
½-½ horizontal.
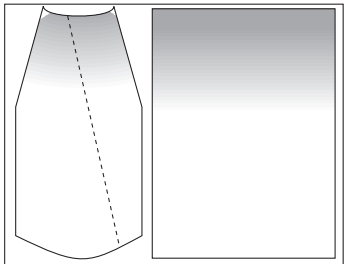
40/60 vertical.
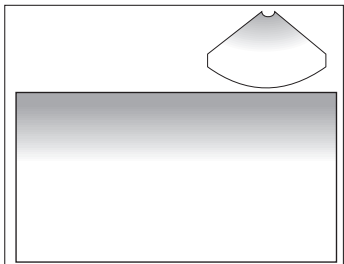
1/3-2/3 horizontal.
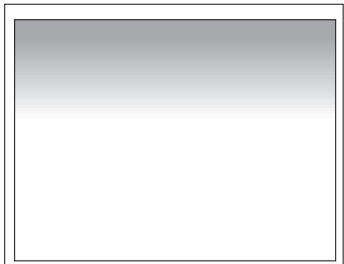
Full Screen (LCD Selection).

System Reference

System Presets   Ch 3

📄
F4

Default Settings
▶ 2D/M and 2D/Doppler
   Display Format

2D/M-Mode Display and Update

Curved array, linear array, and phased array transducers allow a 2D-mode image and an M-mode sweep to display simultaneously in real-time.

Use the system presets to select a horizontal imaging format to enable activation of Split/M-mode.

To activate M-mode, 2D/M-mode, or Split/M-mode:

1. Press the **M** control on the control panel.

    Note: If the cursor bypass is selected in the system presets, the system activates 2D/M-mode immediately; proceed to step 4. If the cursor bypass is not selected, the system initially displays an M cursor on the 2D-mode image.

    The **_M cursor_** is a graphical representation of the acoustic line along which M-mode information is gathered.

2. Roll the trackball to position the M cursor.

3. To activate 2D/M-mode, press the **M** control a second time.

    The system displays a 2D-mode image and an M-mode sweep in the format selected in the system presets. Use the trackball to reposition the M-mode cursor on the 2D-mode image.

4. To activate Split/M-mode, first activate 2D/M-mode and then press the **SPLIT** key on the control panel.

    The system displays two 2D-mode images with the M-mode sweep.

5. To display a full-screen M-mode sweep, press **OFull M** on the M-mode LCD.

    Note: While a 2D/M-mode display is in freeze, you can press the left **DUAL/SELECT** key to toggle a full-screen 2D-mode display on or off, and you can press the right **DUAL/SELECT** key to toggle a full-screen M-mode display on or off.

6. To exit full-screen M-mode or 2D/M-mode, press the **2D** control on the control panel.

Changing the M-Mode Sweep

You can adjust the scrolling speed of the M-mode sweep, activate time markers on the sweep, and specify sweep offset.

Scrolling Speed

Use the **OSweep Speed** LCD selection to adjust the scrolling speed of the M-mode sweep. You can choose from four sweep speeds: **2sec**, **4sec**, **8sec**, and **16sec**. The sweep rate displays in the lower left of the sweep.

The sweep scrolls from the left of the image screen to the right.

To adjust the scrolling speed of the M-mode sweep:

1. Press **OSweep Speed** on the M-mode LCD to activate the selection.

2. Repeatedly press **OSweep Speed** or rotate the **SELECT-R** control to make a selection.

   The last displayed setting becomes the active setting.

Time Markers

Time markers are available for display in the M-mode sweep. Use the system presets to activate the markers. The vertical markers display in intervals in a fixed location on the sweep.

Offset

In 2D/M-mode with a 1/3-2/3 or 1/2-1/2 horizontal sweep, you can offset the 2D-mode image and the M-mode sweep to display specific information more fully on-screen.

To offset the M-mode sweep:

1. Press **OOffset** on the 2D-mode LCD to change the offset setting from **Off** to **On**. If necessary, first rotate the **FUNCTION SELECT** control on the LCD panel to highlight the **2D** tab on the LCD.

2. During 2D/M-mode, roll the trackball vertically and/or horizontally to position the 2D-mode image and M-mode sweep.

System Reference

System Presets   Ch 3

▤
F4

Display
▶ Time Marker Display
Default Settings
▶ 2D/M and 2D/Doppler
   Display Format

2D/M-Mode ▪ Example Screen Layout

The active exam type, transducer, transducer frequency, frames per second, and line density display in the upper left of the image screen. The values of particular imaging parameters display by imaging mode at the bottom of the image screen in the *Imaging Parameters*.

When Dual-mode or 4B-mode is selected, the values display only for the active image. If the image is frozen, the values indicate the setting at the time the image was in real-time. If the system is in 2D/M-mode, both the 2D settings and the M settings are displayed.

Example of screen layout in 2D/M-mode.

1   Imaging depth in mm
2   Active image indicator
3   Offset value (in mm) – displays when ⦿**Offset** is **On**
4   M-mode cursor
5   Focal zone marker
6   Reject settings
7   Gray bar
8   M-mode Imaging Parameters indicating dynamic range, edge enhancement, and gain
9   Transmit Power and MI/TI indices
10 2D-mode Imaging Parameters indicating dynamic range, edge enhancement, and gain
11 Sweep rate
12 DGC curve
13 Frames per second and line density
14 Active transducer name and frequency
15 Active exam type

Imaging Parameters Legend

2D: 60 / 1 / 24   = 2D-mode: Dynamic Range / Edge Enhancement / Gain

M: 40 / 2 / 13   = M-mode: Dynamic Range / Edge Enhancement / Gain

Imaging Parameters

Use the ultrasound system controls and LCD selections to change the settings for imaging parameters. When the system displays multiple images, changing the imaging parameters may affect all images or only the active image. The following information shows imaging parameter behavior for 2D-mode, Dual-mode, Split-mode, 4B-mode, and 2D/M-mode.

- Parameters selectable by controls on the control panel

- Parameters selectable from the 2D-mode LCD

- Parameters selectable from the M-mode LCD

Note: When 2D/M-mode is active, rotate the **FUNCTION SELECT** control on the LCD panel to highlight the **2D** or **M** tab on the LCD.

Note: Frequency, line density, and scan width are transducer-dependent. Also, full-screen M-mode does not support the functions that apply only to 2D-mode images.

Control Panel-Related Imaging Parameters									
		Dual-mode		**Split-mode**		**4B-mode**		**2D/M-mode**	
Parameter	**2D-mode**	**Active**	**Both**	**Active**	**Both**	**Active**	**All**	**2D**	**M**
2D Gain	✓	✓			✓	✓		✓	
Depth	✓	✓			✓	✓		✓	✓
Depth Gain Compensation	✓	✓			✓	✓		✓	✓
Focus	✓	✓			✓	✓		✓	
Frequency	✓	✓			✓	✓		✓	✓
M Gain									✓
L/R	✓	✓			✓	✓		✓	
Scan Width	✓	✓			✓	✓		✓	
Transducer type	✓								
Rotate	✓	✓			✓	✓		✓	✓
Zoom (Magnify)	✓	✓		✓		✓		✓	✓

2D-mode LCD Selections – Imaging Parameters								
		Dual-mode		Split-mode		4B-mode		2D/M-mode	
Parameter	2D-mode	Active	Both	Active	Both	Active	All	2D	M
Color	✓	✓		✓		✓		✓	
Dynamic Range	✓	✓			✓	✓		✓	
Edge Enhance	✓	✓			✓	✓		✓	
Line Density	✓	✓			✓	✓		✓	
Gray Map	✓	✓		✓		✓		✓	
Offset	✓	✓			✓			✓	✓
Reject	✓	✓		✓				✓	
Persistence	✓	✓			✓	✓		✓	
FOV/POS	✓	✓			✓	✓		✓	
SynAps	✓	✓			✓			✓	
Res/Speed	✓	✓			✓	✓		✓	
Output Power (Tx)	✓	✓			✓	✓		✓	✓

The following M-mode imaging parameter LCD selections influence only the M-mode sweep during 2D/M-mode:

- Color
- Dynamic Range
- Edge Enhance
- Gray Map
- Reject

Changing a Transducer Frequency

Use the **MULTIHERTZ** control to change the operating frequency of an active transducer. During mixed-mode imaging with Color Flow, Power, or Doppler, the **MULTIHERTZ** control has no impact on the 2D-mode or M-mode frequency.

The system displays the name of the active transducer and operating frequency in the upper left of the image screen.

C6-2	3.5

Example of active transducer and operating frequency.

Note: During THI imaging, the system displays the frequency followed by a T.

C6-2	4.2T

Example of active transducer and operating frequency for THI imaging.

To change the transducer frequency:

- Push the **MULTIHERTZ** control on the control panel up to increase the frequency or down to decrease the frequency.

  Selecting a higher frequency typically increases resolution, whereas selecting a lower frequency improves penetration.

Changing the Imaging Depth

Maximum and minimum depth selections are dependent upon the frequency of the transducer you are currently using. Depth is adjustable in 10-mm increments.

Use the system presets to specify the rotation direction for decreasing the depth or the magnification factor.

System Reference

System Presets   Ch 3

To change the imaging depth:

▪ Rotate the **DEPTH/ZOOM** control on the control panel.

The imaging depth displays at the bottom left of the image screen. When you are using 2D modes with more than one 2D-mode image, the depth value displays for both 2D-mode images. In Split-mode, rotating the **DEPTH/ZOOM** control changes the depth for both 2D-mode images. In Dual-mode and 4B-mode, rotating the **DEPTH/ZOOM** control changes the depth for the active image.

▤
F4

Customize Keys
▶ Zoom/Depth Direction

Adjusting the Overall System Receiver Gain

Adjust the echo amplification and brightness of a 2D-mode image by rotating the **2D** control. For the M-mode sweep, make this adjustment by rotating the **M** control. This functions as the overall system receiver gain.

The range for gain is 0 dB to 40 dB in 1 dB increments.

The gain value displays in the Imaging Parameters at the bottom of the screen. When you are viewing Dual-mode or 4B-mode with more than one image, the value displays only for the active image. In 2D/M-mode, separate gain values display for the 2D-mode image and the M-mode sweep.

[2] Instructions for Use

Example
  Screen Layout   A2-10

2D:	55/	1/	32

M:	35/	2/	29

Gain (dB) is indicated by the shaded value.

To adjust the overall gain for 2D-mode:

▪ Rotate the **2D** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

To adjust the overall gain for M-mode:

▪ Rotate the **M** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

Adjusting the Depth Gain Compensation (DGC)

To compensate for weak signals or over-bright signals at various depths, you can adjust Depth Gain Compensation (DGC) using the DGC slide controls. The **2D** control adjusts the overall receiver gain and compensates for the brightness of the image.

The DGC provides eight slide controls for adjusting image quality during real time imaging. Move each slide control to the right to increase the gain or to the left to decrease the gain over a 30 dB range.
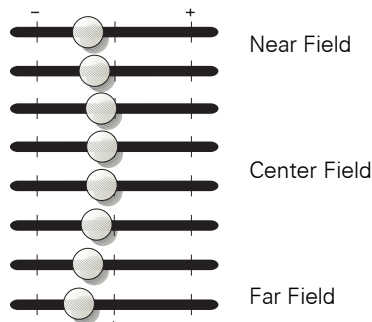
DGC Slide Controls.

Use the system presets to turn on the display of the DGC curve. The curve provides an on-screen representation of the DGC settings.

In 2D/M-mode, DGC adjustments affect both the 2D-mode image and the M-mode sweep.

The DGC slide controls have no effect during CINE.

To adjust the DGC slide controls:

▪ Move a slide control to the right to increase a setting or to the left to decrease a setting.

System Reference

System Presets   Ch 3

▤
F4

Display
▶ DGC Curve Display
General
▶ DGC Invert With
    Image Invert

Changing the Dynamic Range

Adjust the overall contrast resolution of a 2D-mode image using the **◑DR** 2D-mode LCD selection. Use the **◑DR** M-mode LCD selection to adjust the dynamic range for the M-mode sweep. For either mode, repeatedly press the LCD selection or rotate the **SELECT-L** control when the LCD selection is highlighted. For 2D-mode, the dynamic range values are 35 dB to 70 dB in 1 dB increments. For M-mode, the same range of values is available, but in 5 dB increments.

The dynamic range value displays in the Imaging Parameters at the bottom of the screen. In Dual mode or 4B-mode with more than one image, the value displays only for the active image. In 2D/M-mode, separate dynamic range values display for the 2D-mode image and the M sweep.

2D:	55/	1/	32

M:	35/	2/	29

Dynamic range (dB) is indicated by the shaded value.

To change the dynamic range for 2D-mode:

▪ Press **◑DR** on the 2D-mode LCD, or when the LCD selection is highlighted, rotate the **SELECT-L** control clockwise to increase the dynamic range or counterclockwise to decrease the dynamic range.

To change the dynamic range for M-mode:

▪ Press **◑DR** on the M-mode LCD, or when the LCD selection is highlighted, rotate the **SELECT-L** control clockwise to increase the dynamic range or counterclockwise to decrease the dynamic range.

Adjusting the Focus

Select the number of focal zones with the **OFocus** 2D-mode LCD selection. Position the focal zone markers by pushing the **FOCUS** control on the control panel. Focal zone markers display on the left side of the image area.

Curved array, linear array, and phased array transducers support multiple transmit focus points which you can select and position in the image.

Split images both have the same number and position of focal zones. In Dual-mode and 4B-mode, it is possible to have a different number and position of focal zones in each image. During M-mode, Doppler, or Color Flow, only one focal zone is available. The focal zone is always at the position of the Doppler gate in Doppler. During Color Flow, the focal zone is always at the center of the Color ROI.

Single Focal Zone

When you select one (1) focal zone, pushing the **FOCUS** control positions the focal zone marker, regardless of scan depth.

Multiple Focal Zones

When you select two (2) or four (4) focal zones, the spacing between the focal zones adjusts automatically. Pushing the **FOCUS** control adjusts the relative position of the focal zone markers within the field of view. Available positioning depends upon your selected depth.

Using multiple focal zones causes a reduction in the frame rate. The amount of frame rate reduction depends on the depth of view and transducer.

To select the number of focal zones:

1. Press the **OFocus** 2D-mode LCD selection to cycle through the options (1, 2, and 4).

2. To position the focal zones, push up or down on the **FOCUS** control on the control panel.

Changing the Line Density

Use the **◑Density** 2D-mode LCD selection to increase or decrease the number of acoustic scan lines per frame for 2D-mode images. Increasing the line density improves image detail and decreases the frame rate. Frame rate is also dependent on the image width and the imaging depth.

The line density setting displays next to the frame rate in the upper left of the image screen. Selections for line density are:

LCD option	Definition	On screen display
Std	Standard	s
Hi	High	h

To change the line density setting:

- Press **◑Density** on the 2D-mode LCD to toggle the settings.

  The last displayed setting becomes the active setting.

Maximizing Resolution and Speed

Use the **◑Res/Speed** 2D-mode LCD selection to adjust the balance between the scan line density (resolution) and the synthetic aperture. The selections are: Std, Dtl, and Far. Some selections are not available with all transducers.

Note: The **◑SynAps** LCD selection is available for curved and linear array transducers. The **◑PSP** LCD selection is available for phased array transducers.

To change the Res/Speed:

- Press **◑Res/Speed** on the 2D-mode LCD or rotate the **SELECT-R** control when this LCD selection is highlighted.

Res/Speed Setting	Line Density (Resolution)	Synthetic Aperture	Frame Rate
Std	Std	Off	Full rate
Dtl	High	Off	1/2 rate
Far	Std	On	1/2 rate

Synthetic Aperture

Use the **OSynAps** 2D-mode LCD selection to increase the receiving aperture by transmitting twice on the same image line. This technique results in improved resolution, greater penetration at depth, and reduced frame rate. Refer to the Res/Speed description for optimal settings.

Note: The **OSynAps** LCD selection is available for curved and linear array transducers.

To change synthetic aperature:

- Press **OSynAps** on the 2D-mode LCD to select **On** or **Off**.

Changing the Persistence

Persistence provides a visible smoothing effect to the 2D-mode image by persisting lines of image data for each frame of imaging.

Change the persistence for a real-time image by using the **OPersistence** 2D-mode LCD selection. When persistence is set to **0** (Off), all lines of data for each frame are new.

To change persistence:

- Press **OPersistence** on the 2D-mode LCD or rotate the **SELECT-L** control when Persistence is highlighted to cycle through the settings.

  The last displayed setting becomes the active setting.

Changing the Edge Enhancement

Use the **OEdge Enhance** 2D-mode or M-mode LCD selection to distinguish the contours of a structure during real-time imaging. The range of values for edge enhancement is from **0** (none) to **3** (maximum).

The edge enhancement value displays in the Imaging Parameters at the bottom of the screen. In Dual mode and 4B-mode, the value displays only for the active image. In 2D/M-mode, the value displays for both the 2D-mode image and the M-mode sweep.

2D:	55/	1/	32

M:	35/	2/	29

Edge enhancement is indicated by the shaded value.

To change edge enhance:

▪ Press **OEdge Enhance** on the 2D-mode LCD to cycle through the settings.

   The last displayed setting becomes the active setting.

Selecting a Gray Map

During real-time imaging or when the system is in freeze, select the active *gray map* or processing curve by using the **OGray Map** LCD selection. The system assigns the echo amplitudes to gray levels according to the selected gray map.

The active gray map is depicted by a gray bar, which displays on the right side of the image screen. The gray bar represents the range of gray shades available for the selected map.

You can change the appearance of a gray map by using **OReject** in the 2D-mode LCD and M-mode LCD and **OModify Map** in the 2D-mode LCD.

To select a Gray Map using the 2D-mode LCD or M-mode LCD:

▪ Press the **OGray Map** LCD selection or rotate the **SELECT-L** control when the LCD selection is highlighted until the required map label displays in the LCD.

   The label of the selected gray map also displays below the gray bar.

L

Example of a gray bar.

Modifying a Gray Map

Use the **OModify Map** 2D-mode LCD selection to redistribute the range of echo amplitudes assigned to the range of available gray shades for the selected gray map. You can reposition the inflection points within a specific range. The system automatically recalculates the curve and updates the image.

The system has the following settings for gray maps: **L**, **B**, **G**, **C**, **S**, **D**, **A**, or **E**. You can modify all but map **L**.

To modify the map:

1. Select the required map by repeatedly pressing **OModify Map** on the 2D-mode LCD.

    The system overlays the selected map on the image screen. The cursor displays as a box, positioned over the first inflection point.

2. Rotate the **SELECT** control on the control panel to select an inflection point.

3. Roll the trackball to reposition the inflection point.

4. Repeat steps 2 and 3 for each required inflection point.

5. Press the **ESC** key to save the inflection point changes and exit inflection point modification.
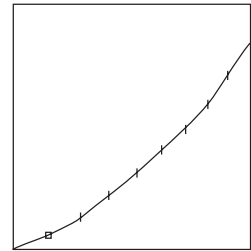
The ten inflection points of a processing curve. The cursor displays as a box, positioned here over the second point.

To:	Perform this action after selecting **OModify Map:**
Select an inflection point	Rotate the **SELECT** control to cycle the cursor through the inflection points.
Reposition an inflection point	Select an inflection point. Roll the trackball reposition the selected inflection point.
	The system restricts movement of the cursor to a specific range.
Select the next point	Rotate the **SELECT** control.
Exit the function	Press the **ESC** key.
	The system saves the modifications and removes the map overlay from the screen. The gray bar displays according to the modified map.

To restore factory defaults for the selected Gray Map:

1. Press **◯Modify Map** to display the map.

2. Press **◯Reset Map** to reset the map to factory defaults.

   If the displayed map has been modified, the system prompts you to confirm the action.

3. Select **OK** to reestablish factory default inflection points for the selected map.

Reject for 2D-Mode and M-Mode

Use the **◯Reject** 2D-mode or M-mode LCD selection to eliminate the display of echoes below a designated level. The selected level displays on the gray bar from **0** (weak echoes) to **64** (strong echoes). Increasing the level removes low to high amplitude signals, and decreasing the level restores the display of high to low amplitude signals.

To establish a 2D-mode or M-mode range of echo amplitudes:

1. Press the **◯Reject** LCD selection to highlight the reject setting.

2. Rotate the **SELECT-L** control clockwise to increase the level or counterclockwise to decrease the level.

   Note: You can also repeatedly press the **◯Reject** LCD selection to increase the selected level. This procedure does not allow for directly decreasing the level, but does wrap from 64 back to 0.

Selecting a Color Map

You can individually colorize the grayscale 2D-mode image and M-mode sweep by applying one of four color maps during real-time imaging or when the system is in freeze.

The system has the following settings for color maps: **Off** (no color applied), **Sepia**, **Mag** (Magenta), **Cool**, and **Bow** (Rainbow).

To apply color to a 2D-mode image or M-mode sweep:

▪ Press **○Color** on the 2D-mode LCD or M-mode LCD or rotate the **SELECT-R** control when this selection is highlighted.

Adjusting the Field of View

Optimize the field of view for curved array, linear array, and phased array transducers using the **○FOV/POS** 2D-mode LCD selection during real-time imaging. Use the **FOV** setting to adjust the sector angle for enhancing the area of interest under examination. Reposition the active, resized 2D-mode image using the **POS** setting (not available for linear array transducers).

The actual angle of the field of view is determined by the geometry of the transducer.

To adjust the field of view:

1. Press **○FOV/POS** on the 2D-mode LCD to select **FOV**.

2. Roll the trackball to the left to decrease or to the right to increase the sector angle of the image.

3. To reposition the resized 2D-mode image, press the **○FOV/POS** selection a second time to select **POS**.

4. Roll the trackball to the right or to the left to reposition the field of view.

5. To exit, press the **○FOV/POS** selection until the **OFF** setting displays.

Changing the Image Orientation

Change the scan direction of a transducer to horizontally flip a 2D-mode image using the **L/R** key. You can also rotate the 2D-mode image or the M-mode sweep so that the near field displays on the right, at the bottom, on the left, or on the top of the image screen by pressing the **ROTATE** key. Each press of the key rotates the image 90°.

Horizontal Orientation

The active image indicator shows the scan beginning point. You can change the scan direction of a transducer by using the **L/R** key to toggle the horizontal orientation of the image, for example, from right-to-left or left-to-right.
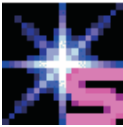
Active image indicator.

Mode	Effect of L/R
Split (B+B) mode	Simultaneously reverses both images
Dual-mode, 4B-mode	Reverses the active image only

To change the horizontal orientation of an image:

- Press the **L/R** key on the control panel.

    The system changes the direction of the scan.

Vertical Orientation

The conventional vertical orientation of an image is to display the near field at the top of the image screen. You can change the display orientation so that the near field displays at the right, bottom, or left of the image screen by using the **ROTATE** key.

Note: Use the system presets to determine if the DGC curve inverts when you press the **ROTATE** key.

Mode	Effect of Rotate
Split (B+B) mode	Simultaneously rotates both images
Dual-mode, 4B-mode	Rotates the active image

To change the vertical orientation of an image:

- Press the **ROTATE** key on the control panel.

    Each press of the key rotates the image 90°.

System Reference

System Presets   Ch 3

▤

F4

General
▶ DGC Invert with
    Image Invert

| | 90° | 180° | 270° |
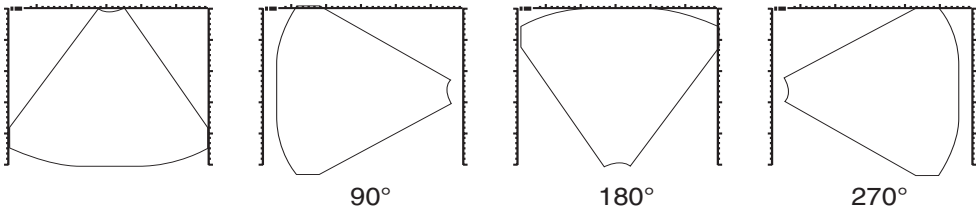
The **ROTATE** key causes the image to rotate clockwise in 90° increments with each press of the key.

Offsetting the Image

Use the 2D-mode **OOffset** LCD selection while imaging in 2D-mode to move the image area to the site of interest, vertically and/or horizontally. When an image is offset, the offset value displays in the upper left side of the image screen. When imaging in Dual-mode, offset values display only for the active image.

To scroll the image vertically and/or horizontally:

1. Press **OOffset** on the 2D-mode LCD to select **On**.

2. Roll the trackball to scroll the image vertically and/or horizontally.

    The amount of offset available depends on the selected transducer.

3. To exit the Offset function, press the **OOffset** LCD selection until the **Off** setting displays.

    The system cancels the offset value and restores the normal image display.

Magnifying the Image

Use the **DEPTH/ZOOM** control on 2D-mode and M-mode images for magnification in real-time or freeze. Pressing the **DEPTH/ZOOM** control places an adjustable zoom window on the image screen. You can roll the trackball to position the window on the region of interest. Adjust the magnification factor by rotating the **DEPTH/ZOOM** control until the window is the appropriate size. Pressing **DEPTH/ZOOM** a second time will magnify the region of interest (ROI). You can reposition the ROI by rolling the trackball.

The following pages provide procedures for using the Zoom function in the various 2D-mode imaging formats and in mixed modes.

Assign the direction of rotation to the **DEPTH/ZOOM** control for increasing the depth or increasing the magnification factor.

You can perform the following actions using the Zoom function:

To:	Perform this action:
To activate the zoom window	Press the **DEPTH/ZOOM** control.
Change the size of the zoom window and/or change the size of the magnified area	Rotate the **DEPTH/ZOOM** control.
Position the zoom window on the image	Roll the trackball.
Magnify the image (portion that displays in the zoom window)	Press the **DEPTH/ZOOM** control.
Cancel zoom and remove the zoom window from the active image	Press the **DEPTH/ZOOM** control again or use the **ESC** key.
Magnify a frozen zoomed image	1. Press the **DEPTH/ZOOM** control. 2. Rotate the **DEPTH/ZOOM** control to adjust the zoom window and then press the **DEPTH/ZOOM** control again.

Magnifying Split Images

When using the Zoom function in a Split image, the image on the left displays the zoom window on the image indicating the area that is being magnified.

To magnify a Split image:

1. Press the **DEPTH/ZOOM** control.

2. Roll the trackball to position the zoom window over the region of interest in the image on the left.

3. Rotate the **DEPTH/ZOOM** control to adjust the size of the zoom window.

4. Press the **DEPTH/ZOOM** control.

    The image on the right increases magnification in the area indicated by the zoom window.

5. Rotate the **DEPTH/ZOOM** control to change the size of the zoom window.

6. Roll the trackball to reposition the zoom window and magnified area.

7. Press the **DEPTH/ZOOM** control to deactivate magnification.

Magnifying a Dual Image

When using the Zoom function in a Dual image, it is possible to apply the function to one or both of the images. You can remove the Zoom function when the image is active.

To magnify a Dual image:

1. Activate Dual-mode images by first pressing the left **DUAL/SELECT** key and then pressing the right **DUAL/SELECT** key on the control panel.

2. Press the **DEPTH/ZOOM** control.

   The zoom window displays in the right (active) image.

3. Roll the trackball to position the zoom window over the region of interest in the active image.

4. Rotate the **DEPTH/ZOOM** control to adjust the size of the zoom window.

5. Press the **DEPTH/ZOOM** control.

   The selected portion of the image is magnified.

6. Press the left **DUAL/SELECT** key to switch the active image.

   The system switches the active image indicator to the left image and freezes both images.

7. Press the **FREEZE** key to unfreeze the active image.

8. Repeat steps 2 through 5 for the left image.

9. To display an image in normal magnification, unfreeze the image and then press the **DEPTH/ZOOM** key.

Magnifying 2D/M-Mode Images

The 2D-mode image and M-mode sweep can be magnified simultaneously.

To magnify the 2D-mode image and M-mode sweep at the same time:

1. From 2D/M-mode, press the **DEPTH/ZOOM** control.

2. Roll the trackball to position the zoom window over the region of interest in the 2D-mode image.

3. Rotate the **DEPTH/ZOOM** control to adjust the size of the zoom window.

4. Press the **DEPTH/ZOOM** control.

   The portion of the image you selected and the M-mode sweep are magnified.

Ensemble Tissue Harmonic Imaging

Ensemble™ Tissue Harmonic Imaging (THI) is a system feature that can enhance contrast resolution with fine tissue differentiation, benefiting difficult-to-image patients.

THI creates 2D-mode images from the received signals using the harmonics of the transmitted (fundamental) frequency. Harmonics are multiples of the fundamental frequency. The system utilizes the harmonics produced in tissue by the non-linear propagation of an ultrasound wave. A pulse sequence technique is used to remove the fundamental signals without affecting the harmonic signals. The harmonic signals have a narrower main lobe and lower side lobes than fundamental 2D-mode signals, resulting in improved spatial and contrast resolution.

To activate THI:

1. Push up on the **MULTIHERTZ** control until "T" displays next to the transmit frequency in the upper left of the image area.

   Note: During Color Flow or Doppler, THI is functional in the 2D-mode image only.

2. To exit THI, push down on the **MULTIHERTZ** control until the "T" is removed from the screen.

[1] Instructions for Use

Compatible
  Transducers   Ch 6

Optimizing Contrast Resolution and Brightness Uniformity (TGO)

The TGO™ Tissue Grayscale Optimization technology optional feature optimizes the image's contrast resolution and brightness uniformity by shifting low-level amplitude signals to the grayscale range optimal for viewing.

When you activate TGO, the system immediately optimizes the image's contrast resolution and brightness uniformity and displays the "TGO" symbol below the active image indicator to indicate that TGO is active. TGO remains active for the current examination until you exit TGO, end the current examination, or select another exam type or transducer.

You can also select an offset (TGO gain) for preferred image brightness with TGO during the current examination (for the current exam type and transducer). The selected value represents the increments of gain adjustment to be added to or subtracted from the default optimized gain.

If you activate a 2D-mode imaging feature that supports TGO (such as THI), then the system automatically updates the optimization for that imaging feature. When you exit TGO, the system removes any gain adjustments you made while TGO was active and removes the "TGO" symbol from the screen to indicate that TGO is no longer active.

You can configure the following documentation controls for TGO activation:

- **PRINT/STORE 1**
- **PRINT/STORE 2**

Example of TGO symbol.

To activate TGO:

Note: TGO affects the whole image including artifacts and defects. For optimal TGO performance, ensure full transducer contact, minimize depth, and avoid bright reflectors (gas),

▪ Press ⭕**TGO** on the 2D-mode LCD, or press the documentation control (**Print/Store 1** or **Print/Store 2**) configured for TGO activation in system presets.

System Reference

System Presets   Ch 3

To select a TGO gain setting (offset):

1. Activate **TGO**.

2. Press ⭕**TGO Gain** on the 2D-mode LCD or rotate the **SELECT-R** control when this selection is highlighted.

To refresh TGO:

▪ Press ⭕**TGO Refresh** on the 2D-mode LCD.

To exit TGO:

▪ While TGO is active, press ⭕**TGO** on the 2D-mode LCD.

A3 Color Flow Imaging

Activating Color Flow Imaging

During Color Flow imaging, the system applies color to a defined **region of interest** (ROI) within the 2D-mode image. You can adjust the depth, location, and size of the ROI, as well as the parameters that affect color imaging performance. When 2D-mode is active, you can initiate Color Flow imaging. A color window, or ROI, displays on the 2D-mode image. The system measures and assigns specific color to the velocities of blood flow within the ROI.

Color Flow Formats

You can add Color Flow to 2D-mode, Doppler, or M-mode. These combined formats are available:

Combined Format	Color Imaging Format
2D-mode with color	2D-mode with Color Flow
2D-mode with color and zoom	Zoomed 2D-mode with Color Flow
Dual-mode with color	Color Flow in Dual-mode, where two separate images are displayed side by side; Color Flow in both images
4B-mode with color	Color Flow in 4B-mode, where four separate images are displayed; Color Flow in all images
Split-mode with color	Color Flow in right image on the screen
M-mode with color	Full-screen M-mode with Color Flow
2D-mode with color/M-mode with color	2D-mode and M-mode displayed with Color Flow in each mode
2D-mode with color and zoom/ M-mode with color and zoom	Zoomed 2D-mode with Color Flow and M-mode with Color Flow
2D-mode with color/Doppler	2D-mode with Color Flow and Doppler; also known as Triplex mode
2D-mode with color and zoom/Doppler	Zoomed 2D-mode with Color Flow and Doppler

To activate Color Flow:

1. Press the **C** control on the control panel.

    The system displays the Color LCD selections and highlights the **C** tab.
    The system also places the ROI, outlined in green, on the image.

2. To reposition the ROI, press **OWindow** on the Color LCD or Power LCD to display **POS** and then roll the trackball to change the position.

3. To adjust the size of the color ROI, press **OWindow** on the LCD to display **Size** and then roll the trackball to change the size.

    Use the small green rectangle at the lower right of the ROI for resizing.

    Note: You can press the **SET** key to toggle the **Size** and **POS**.

4. To exit Color Flow imaging, press the **C** control.

2D-Mode with Color ▪ Example Screen Layout
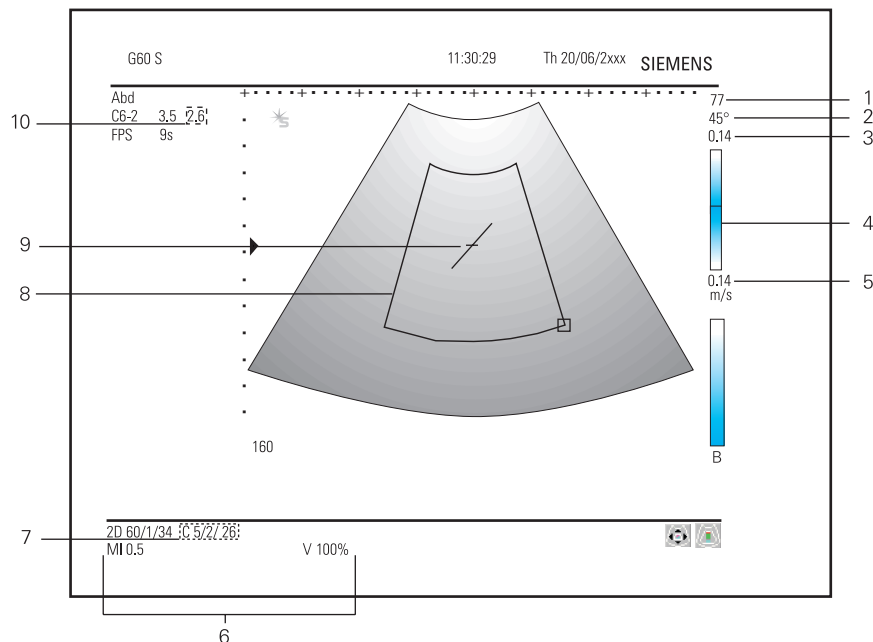
Example of a Color Flow imaging screen.

1 **Color Flow Angle Depth** (mm)

2 **Color Flow Angle Value** — Indicates the flow angle used to calculate corrected flow velocity.

3 **Color Flow Maximum Velocity** (away from transducer) — Displays the velocity range in meters/second (m/s) or centimeters/second (cm/s).

4 **Color Bar** (toward and away from transducer) — Indicates flow direction using 128 shades of red and blue. Changes in the color hue represent changes in velocity. Dark hues indicate low velocities, and brighter hues indicate higher velocities.

   During Power mode: Displays the active power map.

5 **Color Flow Maximum Velocity** (toward transducer) — Displays the velocity range in meters/second (m/s) or centimeters/second (cm/s).

   During Power mode: Displays the frequency range in kilohertz (kHz).

6 **Transmit Power Value and MI/TI Indices**

7 **Color Flow Imaging Parameters** — Indicates the setting for Color Persistence, Motion Cut, and Color Gain in dB.

   During Power mode: Indicates the setting for Power Persistence, Motion Cut, and Power Gain.

8 **Color Window or ROI** — The portion of the image displayed in color. The ROI is outlined with a green line and has the shape of a sector for a curved array or phased array transducer, and the shape of a rectangle or parallelogram for a linear array transducer.

9 **Color Flow Angle Cursor**

10 **Color Flow Transducer Frequency** — Displays to the right of the 2D-mode transducer frequency.

Update Function

The update function displays a frozen 2D-mode with color image with a real-time Doppler spectrum. Use the **UPDATE** key to toggle the two update formats. One format presents a real-time 2D-mode with color image and a frozen spectrum. The other format presents a frozen 2D-mode with color image and a real-time spectrum.

[2] Instructions for Use

Doppler	Ch A4

Note: When the Doppler spectrum is real-time and the 2D-mode with color image is frozen, you can maximize the Pulse Repetition Frequency (PRF) using the update function.

Frozen 2D-mode with color image with real-time Doppler spectrum.

UPDATE

Real-time 2D-mode with color image with frozen Doppler spectrum.

UPDATE

Frozen 2D-mode with color image and real-time Doppler spectrum.

Update without 2D-mode with color-image Refresh.

Update with 2D-Image Refresh

During Update, the system can pause the Doppler spectrum and automatically refresh (update) the 2D-mode with color image according to the interval defined using the **O2D-Update** Doppler LCD selection. Available settings are **1sec**, **2sec**, **3sec**, **4sec**, and **Off**.

To enable the refresh format or change the refresh interval:

1. Rotate the **FUNCTION SELECT** control on the LCD panel to access Doppler selections by highlighting the **D** tab.

2. Repeatedly press **O2D-Update** on the Doppler LCD until the required setting displays.
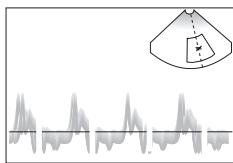
Frozen 2D-mode with color image and real-time Doppler spectrum. 2D-mode with color image is refreshed at interval selected with **O2D-Update** *Doppler LCD.*
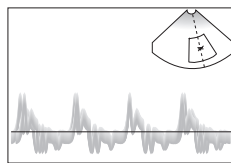
Real-time 2D-mode with color image and frozen Doppler spectrum. No refresh.
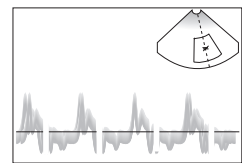
Frozen 2D-mode with color image and real-time Doppler spectrum. 2D-mode with color image is refreshed at interval selected with **O2D-Update** *Doppler LCD.*

Update with 2D-mode with color image Refresh.

Simultaneous Format

You can synchronize the Doppler spectrum and 2D-mode with color image to display simultaneously in real-time.

To enable a simultaneous format:

- Press the **TRIPLEX** key on the control panel.

To disable a simultaneous format:

- Press the **UPDATE** key.

Color Flow Imaging

The Color Flow image can be modified using controls, keys, and LCD selections. The system increases the lighting intensity of the control or key associated with the active function.

Selecting a Flow Stage

Use the **OFlow Stage** Color or Power LCD selection during real-time imaging to optimize the system for hemodynamic flow conditions. The system automatically adjusts the settings for color priority, density, persistence, temporal averaging, motion cut, and noise cut for the selected flow stage(s). These optimizing settings vary by exam type.

Flow Stage Selection	Typically used for
H – high velocity and low resistance	- Carotid - Aorta - Arteries of major organs
HM – medium high velocity	Peripheral vascular
M – medium velocity and high resistance	- Portal veins - Femoral veins or femoral arteries or lower extremities - Vertebrae
ML – medium low velocity	Venous
L – low velocity and low resistance	- Thyroid - Small renal vessels - Breast - Testes - Peripheral veins - Ovarian arteries and veins - Prostate - Lymph system

To select a Flow Stage:

- Press **OFlow Stage** on the Color LCD or Power LCD to cycle through the five flow settings.

Positioning and Sizing the Color Window

When a 2D-mode image is displayed and the **C** control or **POWER** key is pressed, the color window, or ROI, displays on the image. The initial location and shape of the window depend on the active transducer and default imaging depth. Use the **OWindow** Color LCD or Power LCD selection and the trackball to change the size and position of the color window during real-time imaging. When the window size or position is changed, the color information momentarily disappears.

[2] Instructions for Use

Power Mode   A3-22

To change the position of the color ROI:

1. During real-time imaging, press **OWindow** on the Color LCD or Power LCD to toggle the setting to **POS**.

2. Roll the trackball to move the color window. You can position the color window throughout the 2D field of view.

To adjust the size of the color ROI:

1. During real-time imaging, press **OWindow** on the Color LCD or Power LCD to toggle the setting to **Size**.

    Use the small green rectangle at the lower right of the ROI for resizing.

To:	Roll the trackball:
Lengthen the window	Down
Shorten the window	Up
Widen the window	Right
Narrow the window	Left

2. Roll the trackball to change the size of the ROI.

    Note: You can expand the ROI to entirely cover the field of view. This is useful during Power mode imaging.

    Note: You can press the **SET** key to toggle the size and position options for the color ROI.

Steering the Color Window

Steer the color window by using the **STEER** control to improve color sensitivity. The amount of steering available is transducer-dependent and available only with linear array transducers.

Use system presets to automatically convert the color velocity scale when you steer the ROI from left to right or from right to left. This preset is exam-dependent.

To steer the color window:

1. Push the **STEER** control on the control panel.

    Note: The default position of the window depends on the transducer and exam type.

2. Push the **STEER** control to the left to move the ROI to the left. Push the **STEER** control to the right to move the ROI to the right.

    The Doppler cursor is linked to the color window and tracks each steering direction.
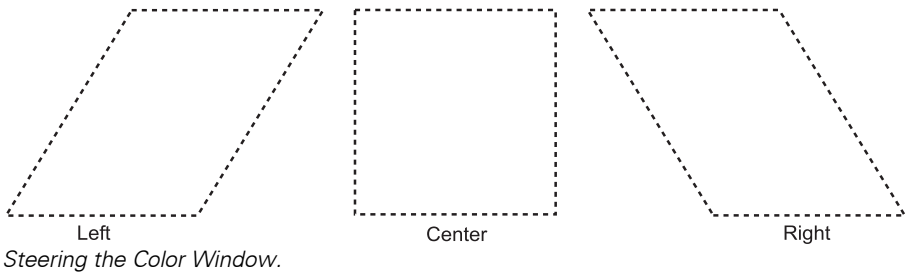
Left   Center   Right

Steering the Color Window.

Linear Array Transducers

With linear array transducers, the color ROI is displayed as a parallelogram.

Note: Increasing the width of the ROI decreases the frame rate. Increasing the depth of the ROI may also decrease the frame rate.

Curved Array and Phased Array Transducers

With curved array and phased array transducers, rather than steer the color window, you can position the sector color window throughout the field of view. The curved color window follows the radial pattern of the image scan lines.

Note: Increasing the width of the ROI decreases the frame rate. Increasing the depth of the ROI may also decrease the frame rate.

Adjusting the Color Flow Gain

Rotate the **C** control to adjust the receive gain for color or power without affecting the 2D-mode image gain. The gain range adjustment for color is 0 to 30 dB in 1-dB increments.

For optimal results, adjust the color gain before adjusting other Color Flow controls. Set the gain level so that random pixels of color appear outside of the vessel of interest, and then reduce the gain until random noise displays.

The gain value displays in the Imaging Parameters at the bottom of the screen.

C:	2/	4/	25
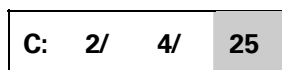
Color or power gain (dB) is indicated by the shaded value.

To adjust the gain for Color Flow imaging:

▪ Rotate the **C** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

Adjusting the Color Filter

Use the **OMotion Cut** Color LCD or Power LCD selection during real-time imaging to increase the level of motion discrimination. You can also rotate the **SELECT-R** control when this selection is highlighted to increase or decrease the level. The range of settings is from **1** to **4**. Higher settings provide more filtering and reduction of motion artifacts. Lower settings provide better sensitivity to lower velocities and small vessel detection, with minimal reduction of motion artifacts.

The motion cut value displays in the Imaging Parameters at the bottom of the screen.

C:	2/	4/	22
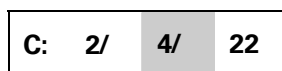
Color or power motion cut is indicated by the shaded value.

To adjust the color filter:

1. To increase filtering, press **OMotion Cut** on the Color LCD or Power LCD or rotate the **SELECT-R** control on the LCD panel clockwise when this selection is highlighted.

2. To decrease filtering, press **OMotion Cut** on the LCD or rotate the **SELECT-R** control counterclockwise.

Changing the Transducer Frequency

Use the **MULTIHERTZ** control to change the operating frequency of an active transducer. During mixed-mode imaging with Color Flow, the **MULTIHERTZ** control changes the Color frequency and the Doppler frequency; it does not affect the 2D-mode or M-mode frequency.

[1] Instructions for Use

Transmit Power   Ch 2
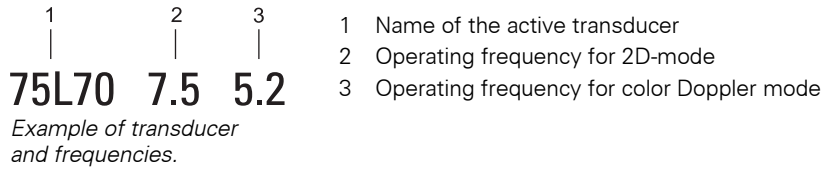
```
 1        2      3
 |        |      |
75L70   7.5    5.2
```
Example of transducer and frequencies.

1 Name of the active transducer
2 Operating frequency for 2D-mode
3 Operating frequency for color Doppler mode

The system displays the name of the active transducer and operating frequency in the upper left of the image screen.

To change the transducer frequency:

- Push up on the **MULTIHERTZ** control on the control panel to increase the frequency. Push down on the **MULTIHERTZ** control to decrease the frequency.

    Selecting a higher frequency typically increases resolution, whereas selecting a lower frequency improves penetration.

Adjusting and Positioning the Field of View

You can adjust the ***field of view*** (FOV) of the 2D-mode image while the color ROI is displayed. Use the **O2D FOV** Color LCD or Power LCD selection to decrease or increase the 2D-mode field of view or reposition the 2D-mode field of view and the color window.

To adjust the 2D-mode Field of View:

1. Press **O2D FOV** on the Color LCD or Power LCD to select the **FOV** setting.

2. Roll the trackball to the left to reduce the 2D-mode field of view or to the right to increase the 2D-mode field of view.

To position the 2D-mode Field of View:

1. Press **O2D FOV** on the Color LCD or Power LCD to select the **POS** setting.

2. Roll the trackball to the left to move the 2D-mode field of view and the Color window to the left. Roll the trackball to the right to move the 2D-mode field of view and the Color window to the right.

To exit 2D-mode Field of View adjustment:

- Press **O2D FOV** on the Color LCD or Power LCD to select the **Off** setting.

Adjusting the Baseline

Use the **BASELINE** control to adjust aliasing in the flow direction under evaluation. If adjusting the baseline does not compensate for very high velocities and aliasing, increase the color PRF to increase the velocity range.

As the baseline is changed, the system updates the values displayed at both ends of the velocity color scale.

When Doppler is active in 2D-mode with color/Doppler, the **BASELINE** control is assigned to positioning the baseline of the Doppler spectrum. Pressing the **UPDATE** key then assigns the **BASELINE** control to the 2D-mode with color display.

To shift the baseline:

Note: Pushing and holding the **BASELINE** control quickly steps through the available positions.

1. To shift the baseline upward, repeatedly push the **BASELINE** control up until the flow is non-aliased.

2. To shift the baseline downward, repeatedly push the **BASELINE** control down until the flow is non-aliased.

Adjusting Color Persistence

Use the **OPersistence** Color LCD or Power LCD selection to determine how long the colors, corresponding to blood flow velocity, remain in the color ROI before decaying or being replaced by another color. Color persistence is determined using a frame-to-frame correlation of the color values.

Peak decay values of color persistence can make it easier to detect pulsatile flow. Averaged values provide the appearance of a smooth flow.

The value for persistence displays in the Imaging Parameters at the bottom of the screen.

C:	2/	4/	45

Color or power persistence is indicated by the shaded value.

To change persistence:

- Press **OPersistence** on the Color LCD or Power LCD until the required setting displays.

  The settings are **0** (off), **1**, **2**, **3**, **4**, **5**, **6**, and **7** (strongest persistence).

Adjusting Color Priority

Use **OC Priority** on the Color LCD or Power LCD to designate rejection of color noise on the 2D-mode image. Rejection levels range from the lowest rejection of **0** to the highest rejection of **12**.

To adjust the color priority:

- Press **OC Priority** repeatedly or rotate the **SELECT-L** control when this LCD selection is highlighted.

Color Flow Angle Correction

The **_flow angle indicator_** depicts the angle of blood flow relative to the transducer. When activated, the system positions the flow angle indicator in the middle of the color window. Use the **ANGLE** control to align the flow angle indicator with the direction of blood flow.

Note: The principles of angle correction for pulsed Doppler also apply to color angle correction.

During color angle correction, the system adjusts the color velocity scale to the corrected velocity range and updates the color data within the color window.

When you first power-on the system, the default setting for vascular exams for the flow angle indicator is at a 60° angle to the acoustic beam of the transducer. Adjusting the position of the angle causes the system to update this value and the velocity scale.

When a flow angle indicator is not displayed in the color window, the system calculates and displays the flow angle at 0° for all array transducers.

To adjust the color flow angle:

1. During 2D-mode with color, press the **ANGLE** control on the control panel.

    The value of the flow angle displays in the upper right of the image screen.

2. Rotate the **ANGLE** control to adjust the flow angle indicator clockwise or counterclockwise.

    The system changes the angle in 1° increments and adjusts the velocity scale in the color bar.

3. To move the flow angle indicator, roll the trackball.

    The gate position displays in millimeters above the angle value in the upper right of the image screen.

Adjusting the Color PRF (Velocity Range)

You can adjust the color velocity range in two ways: by using the color **PRF** control or by adjusting the color baseline. The velocity range is determined by the depth of the color window and by the frequency of the transducer. When the carrier frequency is downshifted, the velocity range increases.

The velocity range can be different for Color Flow imaging than for spectral Doppler and is not linked directly to the spectrum. The color transmit frequency is always the same as the spectral Doppler carrier frequency.

In simultaneous 2D-mode with color/Doppler, the velocity range for color and Doppler is the same because the PRF is the same for each. During Update, you can adjust the PRF for the 2D-mode with color image and for the spectrum separately.

The color velocity scale is displayed as a bar graph along the right side of the image screen. The scale displays a total of 128 shades of color, 64 above and 64 below the center baseline. Values in meters per second (m/s) or centimeters per second (cm/s) are displayed at each end of the color bar to indicate the color Nyquist limit in both directions.

Note: During Power mode, the selected frequency is indicated in kHz on the color bar.

To change the color PRF:

Note: Pushing and holding the **PRF** control quickly steps through the available positions.

1. To increase or shift the scale factor upward, push up on the **PRF** control on the control panel.

2   To decrease or shift the scale factor downward, push down on the **PRF** control.

Using Peak Hold

Peak hold occurs when the ultrasound system accumulates and displays the peak color velocities associated with blood flow for a selected period of time.

Use the **OPeak** Color LCD selection to designate the period of time that peak color velocities of blood flow are collected. Unless you set **OPeak** to **Off**, the system performs peak hold each time an image is acquired.

No other system functions are available during peak hold. Peak hold cannot be initiated from a frozen image. In 2D-mode with color/M-mode and 2D-mode with color/Doppler, you can perform peak hold during Update when the 2D-mode with color image is real-time and the sweep or spectrum is frozen.

To specify the duration of peak hold:

▪ Press **OPeak** on the Color LCD until the required setting displays.

   The selected setting of **1sec**, **2sec**, or **3sec** is the length of time that the system captures peak velocities.

Changing the Line Density

Use the **ODensity** Color LCD or Power LCD selection to increase or decrease the number of acoustic scan lines passing through the color ROI.

LCD setting	Definition
5	Highest frame rate Lowest line density and resolution
4	High frame rate Lower line density and resolution
3	Medium frame rate Medium line density and resolution
2	Lower frame rate High line density and resolution
1	Lowest frame rate Highest line density and resolution

To change the Line Density setting:

▪ Press **ODensity** to cycle through the settings.

   The last displayed setting becomes the active setting.

Adjusting Color Sensitivity

Use the **OTemporal** (Time Averaging) Color LCD or Power LCD selection to optimize the color flow signal-to-noise ratio by controlling the pulse length. The system averages the velocity values for the number of transmit pulses per acoustic line.

To adjust the Field of View:

▪ Press **OTemporal** on the Color LCD or the Power LCD until the required setting displays.

 The settings are **1, 2,** or **3**. A high setting (3) increases sensitivity, but decreases the frame rate.

Smoothing the Flow Pattern

Use the **ONoise Cut** Color LCD or Power LCD to adjust the level of spatial averaging for smoothing the flow pattern display. The system reduces the random noise level by looking at adjacent pixels to determine if a value is real or the result of noise. Higher number settings yield greater color smoothing.

To smooth the flow pattern:

▪ Press **ONoise Cut** on the Color LCD or Power LCD until the required setting displays.

 Increased filtering increases the flow sensitivity, but decreases the spatial resolution.

Selecting a Color Map

During real-time imaging or when the system is in freeze, select the active
color map by using the **⭘Color Map** Color LCD selection. The system
assigns a range of colors, based on your map selection, to apply to the
velocity range for mapping blood flow. The flow direction is indicated using
128 shades of red and blue. Changes in the color hue represent changes in
velocity. Dark hues indicate low velocities, and brighter hues indicate
higher velocities.

LCD setting	Definition
VV1	Velocity plus variance map 1
VV2	Velocity plus variance map 2
VV3	Velocity plus variance map 3
VV4	Velocity plus variance map 4
A	Velocity color map A
B	Velocity color map B
C	Velocity color map C
D	Velocity color map D

The active color map is depicted by the color bar that displays on the right
side of the image screen. The color bar represents the range of color shades
available for the selected map.

0.22

To select a Color Map using the Color LCD:

▪ Press **⭘Color Map** until the required map label displays. You can also
  rotate the **SELECT-L** control when this selection is highlighted to
  change the setting. The system represents the color map selected in
  the color bar.

**To remove the display of Color in a 2D-mode image with color and the
color bar:**

0.22
m/s
*Example of a
Color Bar.*

1. Freeze the image and then press the **C** control.

    The system removes the display of color from the 2D-mode image and
    the color bar from the screen.

2. To redisplay the color in the 2D-mode image and the color bar on the
    image screen, press the **C** control a second time.

Using a Velocity Tag

Use the **◯Vel Tag** Color LCD selection to designate or ***tag*** a specific blood flow velocity or a range of blood flow velocities in a real-time or frozen image or during CINE Review.

Range and point velocity tags are available with all color maps except variance maps. The Velocity tag is not available during Power mode.

To use velocity tagging:

1. Press **◯Vel Tag** on the Color LCD to display **Rng** or **Point** to activate velocity tagging.

    ▪ If **Point** is selected, use the trackball to select a velocity value.

      The system displays all points in the ROI with the selected velocity value in green.

    ▪ If **Rng** is selected, use the trackball to increase or decrease the range of velocity values.

      The system displays all points in the ROI with velocities in the selected velocity range in green.

To position a velocity tag at a single point:

1. Press **◯Vel Tag** on the Color LCD until the **Point** setting displays.

    A green velocity tag marker displays on the color bar.

2. Roll the trackball to position the velocity tag marker at the required point in the color bar and then press the **SET** key to select the value.

    The value for the selected velocity displays to the left of the color bar.

To select a velocity tag range:

1. Press **OVel Tag** on the Color LCD to display the **Rng** setting.

    A green velocity tag marker displays on the color bar. The size and position of the marker in the color bar indicates the range of velocities for display in the Color Flow image. Increase or decrease the size of the marker by rolling the trackball.

2. Define the maximum and minimum velocities of the range. The system displays the maximum and minimum velocity values to the left of the color bar.

    a. Roll the trackball to position the maximum end of the tag marker at the required velocity range and then press the **SET** key.

        Rolling the trackball upward extends the range upward.

    b. Roll the trackball to position the minimum end of the tag marker at the required velocity range and then press the **SET** key.

3. Roll the trackball to position the range of velocities anywhere along the color bar above or below the baseline.

    The system updates the maximum and minimum velocity values.

4. To exit the velocity tag function, press the **ESC** key.

Inverting the Color Scale

Invert the color scale to quickly adjust the color flow to the type of hemodynamics in the image. The color scale can always be inverted in 2D-mode with color, M-mode with color, and 2D-mode with color/M-mode with color, but when Doppler is active, the Invert function affects only the Doppler spectrum. To invert the color scale in 2D-mode with color/Doppler, press the **UPDATE** key to freeze the Doppler spectrum and activate a real-time 2D-mode with color-image, then proceed to invert the color scale.

Use the system presets to automatically invert the color bar when you press the **INVERT** key during 2D-mode with Color/Doppler.

To invert the color scale:

▪ Press the **INVERT** key on the control panel.

   The color scale information is inverted vertically.

Selecting the Color Scale

During color Doppler, the system can display color flow in both directions, towards the transducer only, or away from the transducer only. You can make the following selections for **OColor Scale** on the Color LCD:

LCD Settings	Description
Full	Displays color flow in both directions (red and blue).
Up	Displays color flow toward the transducer only (red).
Down	Displays color flow away from the transducer only (blue).

To select the color scale:

▪ Press the **OColor Scale** selection on the Color LCD until the required LCD setting displays.

You can invert the color scale in color Doppler for all three **OColor Scale** LCD selections.

Increasing Processing Power

Use **OPSP/QSP** on the Color LCD to increase frame rate by adding processing power.

To change the processing power:

▪ Press **OPSP/QSP** on the Color LCD to select **Off** or **PSP.**

   Note: A QSP setting is available for phased array transducers.

Power Mode

Power mode detects and assigns color to the energy generated by the reflections of blood flow. It is independent of the Doppler flow angle. Power mode has a full range of color imaging parameters for optimizing the energy image. These parameters include gain, transmit power, filters, steering, persistence, interim PRF steps, flash, range, and five power maps.

Activating Power Mode

You can use Power mode with any transducer that supports Color imaging during 2D-mode with color and 2D-mode with color/Doppler.

To activate Power mode:

▪ Press the **POWER** key on the control panel.

  The system activates Power mode and displays the Power LCD. The **P** tab at the bottom of the LCD is highlighted when Power mode is active.

Adjusting the Power-Mode Gain

Rotate the **C** control to adjust the receive gain for power without affecting the image gain. The gain range adjustment for color is 0 to 30 dB in 1-dB increments.

For optimal results, adjust the power gain before adjusting other Power controls. Set the gain level so that random pixels of color appear outside of the vessel of interest, and then reduce the gain until random noise displays.

The gain value displays in the Imaging Parameters at the bottom of the screen.

C:	2/	4/	25
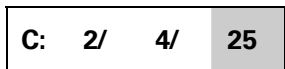
Color or power gain (dB) is indicated by the shaded value.

To adjust the gain for Power imaging:

▪ Rotate the **C** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

Selecting a Power Map

During real-time imaging or when the system is in freeze, select the active *power map* by using the **◐Power Map** Power LCD selection. The power map overlays the gray scale image. The system assigns a range of colors, based on your map selection, to apply to the energy generated by the reflections of blood flow.

LCD setting	Definition
1	Bright yellow to reddish-orange
2	Bright yellow to magenta
3	Light blue to white
4	Medium-gray to white
5	Dark purple to lavender
6	Black to light green

0.22

0.22
kHz
Example of a Color Bar.

The active power map is depicted by the color bar that displays on the left side of the image screen. The power bar represents the range of color shades available for the selected map. The highest amplitude signals are represented by the color shown on the top portion of the bar, and the lowest amplitude signals are represented by the color shown on the lower portion of the bar.

To select a Power Map using the Power LCD:

▪ Press **◐Power Map** until the required map label displays in the LCD.

   The system represents the power map selected in the color bar.

To remove the display of power data in a 2D-mode image with power and the color bar:

1. Freeze the image and then press the **POWER** control.

   The system removes the display of power data from the 2D-mode image and the color bar from the screen.

2. To redisplay the power data in the 2D-mode image and the color bar on the image screen, press the **POWER** control a second time.

Specifying Directional Power

Use the **⭕Dir Power** Power LCD selection to aid in determining power flow relative to the transducer. Four directional power choices are available: **A**, **B**, **C**, and **D**. Each choice activates a color scheme in the upper and lower parts of the power bar. Forward flow (flow towards the transducer) is always represented by the color in the upper half of the power bar; backward flow (flow away from the transducer) is always represented by the color in the lower half of the power bar.

To specify directional power flow:

▪ Press **⭕Dir Power** until the required setting displays on the LCD.

Discriminating Tissue Motion

Use the **⭕Flash** Power LCD selection to select a level of tissue motion discrimination.

To adjust the tissue motion filter:

▪ Press **⭕Flash** on the Power LCD until the required setting displays on the LCD.

The range of settings is from 1 to 5. A high value assigns the maximum amount of flash suppression.

Setting the Power Range

Use the **⭕Range** Power LCD selection to select a power amplitude range from 10 to 70 dB in increments of 5 dB.

To adjust the range:

▪ Press **⭕Range** or rotate the **SELECT-L** control on the LCD panel when this selection is highlighted.

A4 Doppler Functions

Activating Pulsed Doppler

When you activate Doppler from 2D-mode, the **_Doppler cursor_** displays on the 2D image. This cursor is a graphical representation of the acoustic line along which the sample volume or the **_Doppler gate_** is placed for gathering Doppler information. The cursor displays as a row of dots representing 10-mm depths.

Doppler cursor.

Doppler gate.

2D-Mode/Doppler Formats

The default Doppler format is 2D-mode/Doppler in a 1/2-1/2 horizontal presentation. Use the system presets to select your Doppler format preference.

Flow angle indicator. Displays with flow angles other than 0°.

1/2-1/2 horizontal*.

40/60 vertical.

System Reference

System Presets   Ch 3
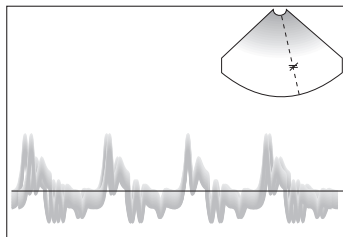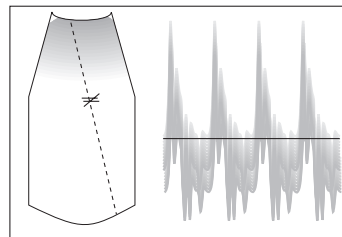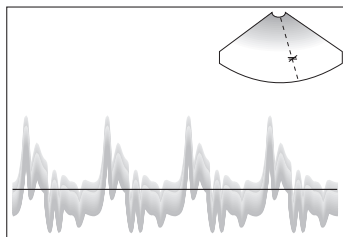
1/3-2/3 horizontal*.
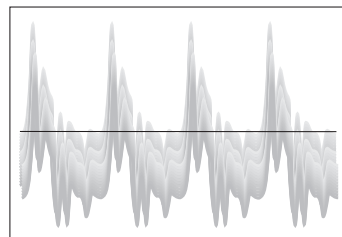
Full Screen (LCD Selection).

*Split/Doppler-mode is only possible using either the 1/2-1/2 format or the 1/3-2/3 format. The 1/2-1/2 format provides a larger 2D-mode image than the 1/3-2/3 format.

F4

Default Settings
▶ 2D/M and 2D/Doppler
   Display Format

To activate pulsed Doppler:

1. Press the **D** control on the control panel.

    Note: If the cursor bypass is selected in the system presets, the system activates 2D-mode/Doppler immediately. If the cursor bypass is not selected, the system initially displays a Doppler cursor on the 2D-mode image.

    The system displays the pulsed Doppler cursor, the Doppler gate, and a *flow angle indicator* on the Doppler gate.

    The Doppler signal is audible *only* when the **Doppler Search Mode** option is selected in the system presets.

2. Roll the trackball to position the Doppler gate on the area of interest.

3. Push the **GATE** control up to increase the size of the Doppler gate or down to decrease the gate size.

    The range of the Doppler gate size is dependent on the transmit frequency of the transducer.

4. If the cursor bypass is not selected, press the **D** control again.

    The LCD lists Doppler selections, and the system displays 2D-mode /Doppler using the image format selected in the system presets.

    The 2D image is frozen and the Doppler spectrum initially displays in real-time.

▤

F4

Default Settings
▶ Doppler Search Mode
▶ 2D/M and 2D/Doppler
  Display Format
▶ Bypass M/D Cursor
  Display

To:	Perform this action after activating pulsed Doppler:
Initiate a full-screen Doppler spectrum	Press **◗Full D** on the Doppler LCD to activate full-screen Doppler.
Observe repositioning of the Doppler cursor when viewing the full-screen Doppler spectrum	Press **◗Full D** on the Doppler LCD to deactivate full-screen Doppler, Reposition the cursor by rolling the trackball, and press **◗Full D** on the LCD a second time to reactivate full-screen Doppler spectrum.
Change the interval for refreshing the 2D image during Update	Press **◗2D Update** to change the setting (**Off**, **1sec**, **2sec**, **3sec**, or **4sec**).
Freeze the spectrum	Press the **FREEZE** key.
Activate another mode	Press the required mode key.

2D-Mode/Doppler ▪ Example Screen Layout
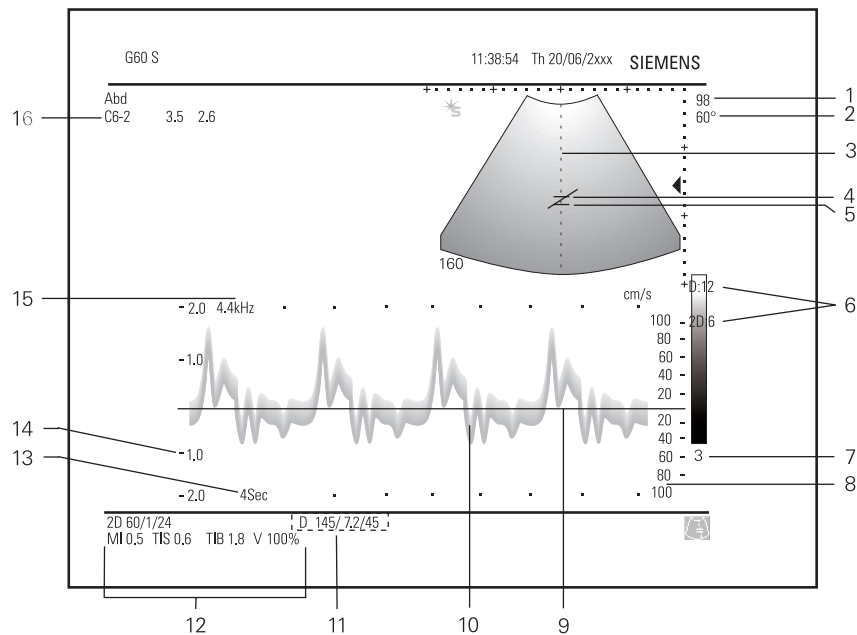
Example of a pulsed Doppler imaging screen in 2D-mode/Doppler.

1   Doppler gate depth (mm)
2   Flow angle value
3   Doppler cursor
4   Flow angle indicator
5   Doppler gate (sample volume)
6   Reject settings
7   Doppler spectrum gray scale
8   Velocity scale (cm/s)
9   Baseline
10 Spectrum
11 Doppler Imaging Parameters indicating wall filter in Hz, gate size in mm, and Doppler gain in dB
12 Transmit power value and MI/TI indices
13 Sweep rate
14 Frequency scale (kHz)
15 PRF
16 Transducer and transducer frequency

Image Parameter Legend

2D: 60 / 1 / 24   = 2D-mode: Dynamic Range / Edge Enhancement / Gain

D: 145 / 7.2 / 45 = Doppler: Wall Filter / Gate Size / Doppler Gain

Activating DTI

DTI™ Doppler Tissue Imaging is available with certain transducers. DTI illustrates movement of tissue by emphasizing low myocardial velocities.

DTI measurements can facilitate quantification of tissue movement. For example, you can measure the velocity of local myocardial movement without the need to compensate for movement of the entire heart.

When you activate DTI, the system adjusts the velocity scale to emphasize low myocardial velocities and adjusts the Post Process setting and the Doppler gate size setting according to the default value or to the last value you set during DTI.

Note: **HPRF** is disabled during DTI. Available values for **Scale** during DTI are 1.3 to 4.4.

To activate DTI:

1. Select a DTI-compatible transducer.

2. Activate pulsed Doppler or a mixed imaging mode including pulsed Doppler.

3. Roll the trackball to position the Doppler gate on the tissue of interest.

4. Press **⊙DTI** on the Doppler LCD to activate DTI.

5. To exit DTI, press **⊙DTI** again.

Activating Doppler Search Mode

Use ***Doppler Search Mode*** to audibly interrogate vessels with Doppler in 2D-mode before displaying the Doppler spectrum. Use the system presets to configure the system to initiate Doppler Search mode whenever the **D** control is first pressed. When Doppler Search mode is active, the system displays a Doppler cursor in the 2D-mode image and displays 2D-mode selections on the LCD.

Note: Activating this function reduces the frame rate.

Activating M-Mode/Doppler

When M-mode is active with Doppler, the M-mode sweep is always synchronized with the Doppler spectrum. Beam steering cannot be activated in 2D/M-mode/Doppler. If beam steering is required, exit M-mode.

2D/M-Mode/Doppler Formats

The system presents 2D/M-mode/Doppler in a 40/60 vertical format. The 2D/M and 2D/D Display Format selection in the system presets does not affect the 2D/M-mode/Doppler presentation.
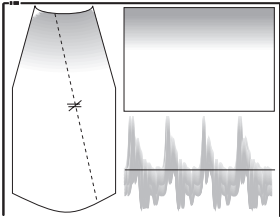
2D/M-mode/Doppler 40/60 vertical.

To activate M-mode/Doppler:

1. Press the **D** control on the control panel.

    Note: If the cursor bypass is selected in the system presets, the system activates 2D-mode/Doppler immediately. Proceed to step 4.

    The system displays the pulsed Doppler cursor and Doppler gate in the 2D image. A flow angle indicator displays on the Doppler gate.

2. Roll the trackball to position the Doppler gate on the area of interest.

3. Press the **D** control.

4. Press the **M** control.

    The M-mode sweep is always synchronized with the Doppler spectrum. The LCD lists M-mode selections, and the screen displays 2D/M-mode/Doppler.

5. To exit Doppler and M-mode, press the **2D** control.

System Reference

System Presets	Ch 3

▤
F4

Default Settings
▶ Bypass M/D
   Cursor Display

Update Function

The update function displays a real-time Doppler spectrum with a frozen 2D-mode image. Use the **UPDATE** key to toggle a real-time 2D image and a frozen spectrum with a frozen 2D image and real-time spectrum.

Frozen 2D image with real-time Doppler spectrum.

UPDATE

Real-time 2D image with frozen Doppler spectrum.

UPDATE

Frozen 2D image and real-time Doppler spectrum.
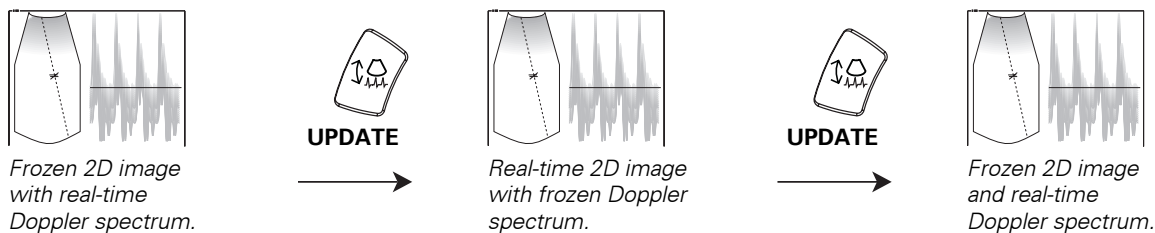
Update without 2D-image Refresh.

Update with 2D-Image Refresh Interval

During Update, the system can pause the Doppler spectrum and refresh the 2D-mode image according to the interval defined using the **O2D Update** Doppler LCD selection. Available settings are **1Sec**, **2Sec**, **3Sec**, and **Off**.

To enable the refresh format or change the refresh interval:

1. Access the Doppler LCD selections by rotating the **FUNCTION SELECT** control on the LCD panel to highlight the **D** tab.

2. Press **O2D Update** to select a refresh setting.

*Frozen 2D image with real-time spectrum. 2D image is refreshed at interval selected with **O2D Update** Doppler LCD.*

UPDATE

Real-time 2D image with frozen Doppler spectrum.

UPDATE

*Frozen 2D image with real-time spectrum. 2D image is refreshed at interval selected with **O2D Update** Doppler LCD.*
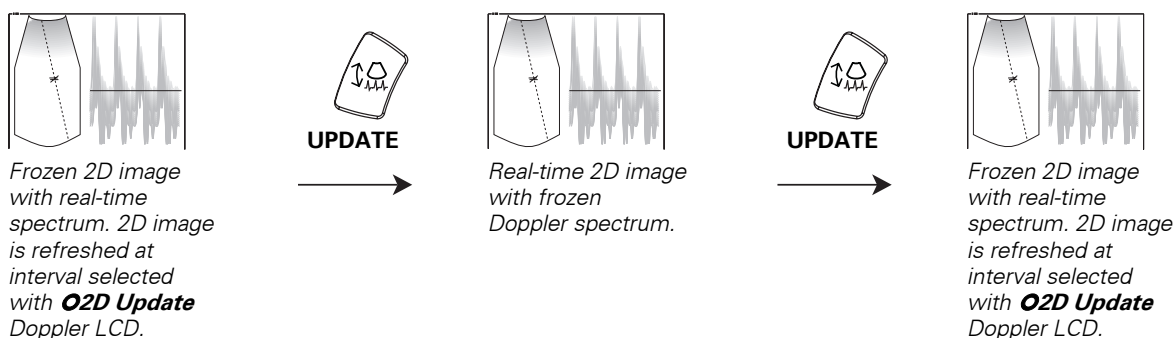
Update with 2D-image Refresh.

Simultaneous Format

You can synchronize the Doppler spectrum and 2D-mode image to display simultaneously in real-time. A simultaneous format is not available with SCW Doppler.

During 2D/M-mode/Doppler, the M-mode sweep is synchronized with the Doppler spectrum.

To enable a simultaneous format:

- Press the **TRIPLEX** key.

To disable a simultaneous format:

- Press the **UPDATE** key.

Activating Auxiliary Continuous Wave Doppler

Auxiliary continuous wave Doppler is possible with the use of CW transducers or **_pencil_** transducers. The frequency of a pencil transducer cannot be changed.

Note: Operating continuous wave in close proximity to sources of strong radiated electromagnetic fields, such as radio transmission stations or similar installations, may lead to interference visible on the monitor screen.

To activate auxiliary continuous wave Doppler:

1. Press the **TRANSDUCER** key on the control panel.

    The LCD lists transducer selections.

2. Select a continuous wave transducer from the LCD list.

    The system activates continuous wave Doppler, scrolling the Doppler spectrum across the image screen.

Activating Steerable Continuous Wave Doppler

(Requires the Cardiac Imaging Option)

Steerable continuous wave Doppler is possible with a phased array transducer. The following two procedures outline SCW Doppler operation with and without cursor bypass. Use the system presets to check or change the cursor bypass setting.

To activate steerable continuous wave Doppler with cursor bypass activated:

1. Press the **CW** key on the control panel.

   The system displays a 2D image and a Doppler spectrum. A ***diamond*** displays on the Doppler cursor in the 2D image; it represents the focal point for SCW Doppler.

2. Roll the trackball to position the Doppler cursor on the area of interest.

   The LCD lists Doppler selections, and the system displays 2D-mode/Doppler using the image format selected in the system presets.

3. To exit, press the **2D** control on the control panel.

To activate steerable continuous wave Doppler with cursor bypass deactivated:

1. Press the **CW** key on the control panel.

   The system displays the pulsed Doppler cursor in a full-screen 2D image. A ***diamond*** displays on the Doppler cursor; it represents the focal point for SCW Doppler.

2. Roll the trackball to position the Doppler cursor on the area of interest.

3. Press the **CW** key again.

   The LCD lists Doppler selections, and the system displays 2D-mode/Doppler using the image format selected in the system presets.

4. To exit, press the **2D** control on the control panel.

[2] Instructions for Use

Search mode	A4-6
Update	A4-8
Refresh	A4-8

System Reference

System Presets	Ch 3

🗏

F4

Default Settings
▶ Doppler Search Mode
▶ Bypass M/D
   Cursor Display

Doppler Parameters

The Doppler spectrum can be modified using controls and keys on the control panel and LCD selections on the LCD panel. As with most controls for imaging in 2D-mode and M-mode, the system increases the lighting intensity of the control or key associated with the active function.

Selecting Frequency or Velocity

Select a Frequency or Velocity scale for the Doppler spectrum using the **OScale** selection on the Doppler LCD. Frequency (**Freq**) displays a scale in kHz to left of the spectrum. Velocity (**Vel**) displays velocity markers in cm/s to the right of the spectrum. **F/V** displays both the frequency scale on the left and the velocity scale on the right.

To select a frequency or velocity scale:

Note: Push up on the **PAGE** control to access the second page of LCD selections.

▪   Press **OScale** on the LCD to select the required scale, **Vel** (Velocity), **Freq** (Frequency), or **F/V** (Frequency and Velocity).

Note: Changing from a velocity scale to a frequency scale causes the system to recalculate calculations or measurements from velocity (cm/s) to frequency (kHz). Existing frequency calculations or measurements remain as kHz when changing from a frequency scale to a velocity scale.

Effect of Other Imaging Parameters

When you downshift the transmit frequency, change the baseline, or change the PRF, the scale adjusts accordingly (after a temporary pause in the spectrum).

Positioning and Steering the Doppler Cursor

You can position and **_steer_** the Doppler cursor in relation to the vessel or pathology of interest to obtain the required angle of incidence. Positioning and steering are transducer-dependent.

Note: Beam steering cannot be activated in 2D/M-mode/Doppler. If beam steering is required, exit M-mode.

Phased and Curved Array Transducers

Use the trackball to position the Doppler cursor throughout the field of view. Steering is not available with phased and curved array transducers.

Linear Array Transducers

You can steer and position the Doppler cursor with linear array transducers.

To steer the Doppler cursor:

- Push the **STEER** control left or right.

  Pushing the **STEER** control to the left or right cycles through positions available in the respective direction. The default position of the Doppler cursor is in the center.

  Selections include two positions left of center, center, and two positions right of center.

To position the Doppler cursor:

- Roll the trackball to position the Doppler cursor throughout the field of view. You can position the Doppler cursor before or after steering.

Positioning the Doppler Gate

The **_Doppler gate_** displays on the Doppler cursor in the 2D image. Roll the trackball up or down to position the gate on the cursor. Roll the trackball right or left to position the cursor in the image. The depth of the gate displays outside the upper right of the 2D image.

Pulsed Doppler gate.
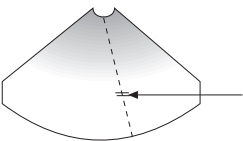
Sizing the Doppler Gate

For pulsed Doppler, adjust the size of the Doppler gate by using the **GATE** control on the control panel. The range of the Doppler gate size is dependent on the transmit frequency of the transducer.

D: 100/ 4.8 /45

Gate size (mm) is indicated by the shaded value.

To change the size of the Doppler gate:

Note: Pushing and holding the **GATE** control quickly steps through the available positions.

1. To increase the size of the Doppler gate, push the **GATE** control up.

2. To decrease the size of the Doppler gate, push the **GATE** control down.

Angle Correction

The *flow angle indicator* depicts the degree of angle correction for the Doppler spectrum. Use the **ANGLE** control on the control panel to rotate the flow angle indicator. The indicator value displays in the upper right of the image area.

When you first activate Doppler, the display of the flow angle indicator to the Doppler cursor is exam-dependent.

Vascular studies   60° angle

All other exams   0° angle
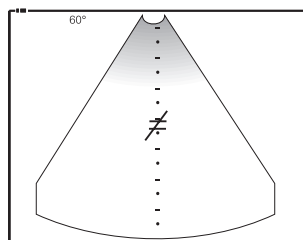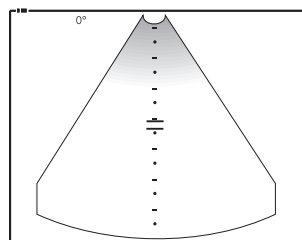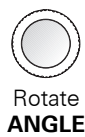
| Example: Position A | Example: Position B | Example: Position C |
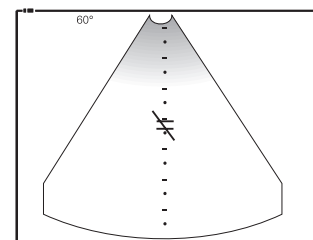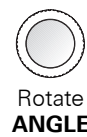
Accurate Doppler shifts can be calculated for angles of 64° or less. The system indicates flow angles greater than 64° by highlighting the angle value.

To correct the flow angle:

- Rotate the **ANGLE** control to change the flow angle. Press the **ANGLE** control to select 0° automatically.

- To reposition the gate on the Doppler cursor, roll the trackball up or down.

Adjusting the Baseline

Adjust the baseline position using the **BASELINE** control. There are nine available positions for the baseline. When the baseline position has been changed, the scrolling spectrum restarts at the new position. On-screen frequency and velocity scales also update.

To shift the baseline:

Note: Pushing and holding the **BASELINE** control quickly steps through the available positions.

1. To shift the baseline upward, push the **BASELINE** control up until the baseline displays in the required position.

2. To shift the baseline downward, push the **BASELINE** control down until the baseline displays in the required position.

Adjusting Doppler Gain

Adjust Doppler gain by rotating the **D** control. The Doppler gain controls the overall gain for pulsed Doppler. The gain range is 30 dB to 60 dB in 1 dB increments.

The gain value displays in the Imaging Parameters at the bottom of the screen.

D:	100/	4.8/	45
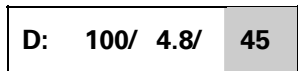
Doppler gain (dB) is indicated by the shaded value.

To adjust gain for Doppler imaging:

▪   Rotate the **D** control clockwise to increase gain and counterclockwise to decrease gain.

Changing the Transducer Frequency

Use the **MULTIHERTZ** control on the control panel to change the operating frequency of an active transducer. During mixed-mode imaging with Color Flow, the **MULTIHERTZ** control changes the Color frequency and the Doppler frequency; it does not affect the 2D-mode or M-mode frequency.

```
   1      2     3
   |      |     |
75L70   7.5   5.2
```
Example of a downshifted
Doppler frequency (upper left of screen).

1   Name of the active transducer
2   Operating frequency for 2D-mode
3   Operating frequency for Doppler mode

The system displays the name of the active transducer and operating frequency in the upper left of the image screen.

To change the transducer frequency:

- Push the **MULTIHERTZ** control on the control panel up to increase the frequency or down to decrease the frequency.

    Selecting a higher frequency typically increases resolution, whereas selecting a lower frequency improves penetration.

Adjusting the Wall Filter

The system calculates the wall filter threshold value as a multiple of the PRF. Pressing the **OFilter** LCD key and/or pushing the **PRF** control will change the wall filter value. You can only change the wall filter during a real-time spectral sweep. The change affects the audio signal.

OFilter LCD Setting	PRF Multiple
0	0.017
1	0.033
2	0.050
3	0.067
4	0.083
5	0.100
6	0.133

For example, a PRF of approximately 7.8 kHz and a **OFilter** LCD setting of 3 (multiple of 0.067) yield a displayed wall filter value of 525 Hz.

The wall filter value displays in the Imaging Parameters at the bottom of the screen.

| D: | 525 | /4.8 | /45 |
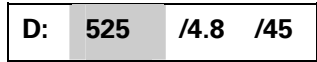
Wall filter (Hz) is indicated by the shaded value.

To change the wall filter:

▪ Press the **OFilter** LCD key to cycle through the available settings.

Adjusting the PRF

The PRF (Pulse Repetition Frequency) is dependent on the transmit frequency and the depth of the Doppler gate.

Each time you push the **PRF** control, the Doppler display blanks as the system restarts the spectrum at the new PRF setting and adjusts the scale.

During simultaneous, Triplex display (the 2D-mode image and Doppler spectrum are active), curved and linear array transducers use up to half the available PRF. In Update, the full PRF range is available for all Doppler-compatible transducers. HPRF is also possible using the **⭘HPRF** LCD selection.

To adjust the PRF:

Note: Pushing and holding the **PRF** control quickly steps through the available positions.

1. To increase or shift the scale factor upward, push the **PRF** control up.

2. To shift the scale downward, push the **PRF** control down.

Activating HPRF

HPRF detects and depicts higher velocity flows using the maximum scale. An example of high velocity is the abnormal flow due to high-grade stenosis. Without HPRF, the signal aliases, and quantifiable analysis is difficult. Using HPRF, the system places additional Doppler gates in the 2D-mode image and expands the velocity scale of the Doppler spectrum.

When the **⭘HPRF** selection is **On** the system automatically activates HPRF when the Doppler gate reaches specific depths in the image and when the signal exceeds the upper level of the active scale.

HPRF is available only in Update; it is not available in a simultaneous, Triplex Doppler format.

To activate HPRF:

1. During Update when the 2D-mode image is frozen and the Doppler spectrum is active, press **⭘HPRF** to toggle from **Off** to **On**.

2. Push the **PRF** control up to shift the scale.

    The system displays additional sample gates in the 2D image.

Adjusting Echo Amplitude

Use the **O Reject** Doppler LCD selection to eliminate the display of echoes below a designated level. The selected level displays on the gray bar from **0** (weak echoes) to **64** (strong echoes).

To establish a range of echo amplitudes:

▪ Press **O Reject** on the Doppler LCD to select a new echo amplitude. You can also rotate the **SELECT-L** control on the LCD panel when **O Reject** is highlighted to select the reject level. Rotate this control clockwise to increase the level and remove low to high amplitude signals from the gray scale image. Rotate this control counterclockwise to decrease the level and restore the display of high to low amplitude signals.

D:2

Example of a Gray Bar with Reject setting for Doppler.

Enhancing the Doppler Spectrum

Use the **O Pre Process** Doppler LCD selection to select a curve for enhancing the Doppler spectrum.

Settings	Definition
0	Low contrast and low dynamic range.
1	Smoothest display, low contrast and high dynamic range.
2	High contrast and mid dynamic range.
3	High contrast and low dynamic range.

To enhance the Doppler spectrum:

▪ Press **O Pre Process** on the Doppler LCD to select one of four curves to change the contrast and dynamic range (**0**, **1**, **2**, or **3**).

Changing the Gray Scale

Use the **O Post Process** Doppler LCD selection to change the appearance of the Doppler spectrum (gray scale) for the displayed image.

To select the gray scale:

▪ Press **O Post Process** on the Doppler LCD to select one of eight gray scales (**0**, **1**, **2**, **3**, **4**, **5**, **6**, or **7**).

Tracing the Doppler Spectrum

The Doppler LCD has selections for displaying a graphical trace that tracks maximum, minimum, mean, and mode velocities or frequencies. You can display up to two of the four available selections on a real-time or frozen spectrum. On-screen labels identify the selected trace(s).

The trace selections are distinguished with the following colors: **Max** is white, **Min** is red, **Mean** is yellow, and **Mode** is blue.

To display the trace data above and below the baseline, select the **Full** setting on the spectrum option for a **○Trace Max, ○Trace Min**, **○Trace Mean**, or **○Trace Mode** LCD selection. To display a trace above the baseline only, select the **Up** setting.

Manual Trace

A manual (**Man**) trace method is only available for use during the measurement function with the Pulsatility Index calculation and only when the spectrum options **○Trace Max**, **○Trace Min**, **○Trace Mean**, and **○Trace Mode** are set to **Off**. This provides trackball control for a manual spectrum trace. To activate manual trace, press **○PI Trace** on the Doppler measurement LCD, and then press **○PI Manual**.

[2] Instructions for Use

Pulsatility Index   Ch B1

Max

Min

Mode

Mean
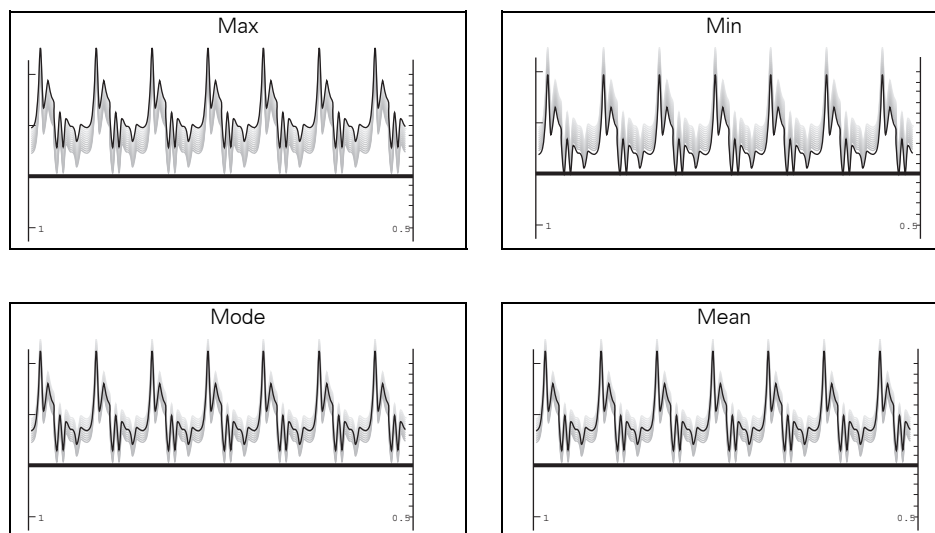
Trace options.

Adjusting the Sweep Speed

Use the **OSweep Speed LCD selection** to adjust the scrolling speed of the M-mode sweep or the Doppler spectrum. You can set the sweep speed by selecting from four sweep durations: **2sec**, **4sec**, **8sec** or **16sec**. The actual sweep rate is displayed at the lower left of the sweep.

The M-mode sweep or the Doppler spectrum scrolls from the right of the image area to the left.

To adjust the scrolling speed of the M-mode or Doppler sweep:

- Press the **OSweep Speed LCD selection** to cycle through the available settings.

Displaying Time Markers

Time markers can display in the Doppler spectrum or M-mode sweep. Use the system presets to activate the markers.

The markers display in half-second intervals in a fixed location on-screen. They do not scroll with the sweep.

Inverting the Spectrum

Use the **INVERT** key to flip the spectral information vertically on the spectral baseline. The scale remains the same and the word *INVERT* displays next to the frequency scale.

To invert the spectrum:

- Press the **INVERT** key on the control panel.

  The Doppler spectrum flips vertically. Doppler audio also inverts.

Adjusting Doppler Volume

Speakers located inside the monitor housing emit audio during Doppler. Separate audio signals indicate forward or reversed flow direction. Typically, flow moving toward the transducer displays above the Doppler baseline and delivers audio from the right speaker. Flow moving away from the transducer displays below the baseline and emits audio from the left speaker.

When the Doppler spectrum is inverted, the audio signal also inverts.

To adjust the Doppler volume:

▪ Adjust overall Doppler volume with the **VOLUME** control on the LCD panel. Rotate this control clockwise to increase the volume and counterclockwise to decrease the volume.

Adjusting Audio Balance

Adjust Doppler audio balance between the left and right speakers by using **⭕Audio Balance** on the Doppler LCD.

To adjust audio balance:

▪ Press **⭕Audio Balance** or rotate the **SELECT-L** control on the LCD panel when **Audio Balance** is highlighted.

▪ Adjustment range is from –8 to +8.

▪ Negative values assign greater volume to the left speaker, and positive values assign greater volume to the right speaker.

▪ Leave this setting at 0 for optimal performance.

Colorizing the Doppler Spectrum

You can colorize the Doppler spectrum independent of the gray scale image or sweep by applying one of four color maps during real-time imaging or when the system is in freeze.

The system has the following settings for color maps: **Off** (no color applied), **Sepia**, **Mag** (Magenta), **Cool**, and **Bow** (Rainbow).

To apply color to a Doppler spectrum:

▪ Press **○Color** on the Doppler LCD to cycle through the settings.

A5 CINE

CINE

The CINE function is available in all imaging modes except 4B-mode and 2D/M-mode with Doppler. During real-time imaging, the system places the most recently acquired images as well as the image currently on screen into a CINE memory buffer. You can view images stored in CINE memory using a review method.

- **Frame Review** – The Frame function is the system default. Use the trackball to cycle through the frames of data, one at a time, either forward or backward. You can also use the Frame function to select individual frames for printing or for storing on a disk.

- **Motion Review** – The Motion function provides a continuous display of stored data in the forward direction only. Data can be played back at the same frame rate at which the data was acquired, or the playback speed can be adjusted. All of the available frames can be viewed, or a segment can be selected using the **Edit Start** and **Edit End** options.

CINE Memory Buffer ▪ First In, First Out

You can review any or all of the image data in the CINE memory buffer. When the CINE memory buffer is filled, the first data acquired is the first to be replaced. This process of overwriting data is continuous. Unfreezing the system erases the data from the CINE memory buffer and restarts the acquisition of CINE data.

Memory Buffer Capacity

The amount of storage available in the CINE memory buffer depends on the image complexity (setting for the **ⓄDensity** LCD selection), mode combinations, and the active exam type.

Doppler or M-mode

The maximum CINE memory capacity for Doppler and M-mode depends on the sweep speed. The capacities are the same for NTSC and PAL systems.

Sweep Speed	Storage
2sec	15 seconds
4sec	30 seconds
8sec	60 seconds
16sec	120 seconds

Partially Filled Memory Buffer

If the acquired frames of CINE data do not fill the CINE memory buffer, the system displays a vertical marker on the CINE graphic, indicating how much of the CINE memory buffer is available for review.

201◣＿＿＿＿＿▼｜

CINE data available for review.

Note: If the memory buffer has been cleared and the system is not filled to capacity with CINE frames, only the newly-acquired frames are present.

CINE Indicator

During CINE Review, a **CINE indicator** displays in the lower right of the image screen. This CINE icon represents the status of the CINE memory buffer with the following information:

- Position of the currently displayed frame within the CINE data

XX◣ ▽ ◢ ⌐
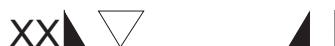
Arrow indicates location of frame within the loop of data.

- During Frame Review of 2D-mode or 2D-mode with color images, the number of the active frame displays to the left of the CINE indicator on the image screen.

127 ◣ ▽ ◢

Current frame number under review.

- Identifies an edited segment in a loop of data

94 | ◣▽◢ ⌐

Markers indicate the edited segment of CINE data using ❍**Edit Start** *and* ❍**Edit End** *LCD selections.*

Activating CINE Review

The CINE memory buffer continuously accumulates data during real-time imaging. When CINE is activated, the accumulation process stops, and the data in the memory buffer is available for replay, printing, or storage to a disk medium.

CINE Review can be activated manually, or preset to activate when the system is frozen. Use the system presets to assign the **FREEZE** key to activate CINE.

To activate CINE Review:

- If the automatic freeze response is set to CINE in the system presets, press the **FREEZE** key on the control panel to activate the CINE Review function. Otherwise, press the **FREEZE** key, and then press the **CINE** key on the control panel to activate the CINE Review function.

    The system activates Frame Review and displays the corresponding LCD selections.

To exit CINE Review:

- Press the **FREEZE** key to exit the CINE Review function and resume real-time imaging.

System Reference

System Presets   Ch 3

▤

F4

Default Settings
► Automatic Freeze
   Response

Resetting CINE Memory

The following actions reset CINE memory; the CINE memory buffer empties and the system begins acquiring new data:

- Unfreezing an image
- Changing or re-selecting an imaging mode
- Changing or re-selecting the exam type or a QuickSet
- Changing the transducer or transducer frequency
- Powering off the system
- Pressing **F1** (New Patient) or the **NEW PATIENT** key

CINE memory also resets in response to certain commands or functional changes performed during real-time imaging.

The following system settings or changes to the system **will** reset the memory:

Depth	Window (size or position)	Sweep
Focus (LCD)	PRF	Zoom
Line Density	Baseline (Doppler)	Gate Position (Doppler)
Persistence	Dynamic Range	Steer
Rotate (2D/M)	Invert (spectrum)	

The following system settings or changes to the system **will not** reset the memory:

L/R	Cursor Position (Doppler)	Flow Angle
Offset	Gate Size	Gain
	Reject	Transmit Power
	Cursor Position (M-mode)	

Frame Review

The Frame Review method provides access to any frame in the loop of data. You can edit the beginning and ending positions of the loop.

To review CINE data using the Frame method:

1. Activate CINE.

2. Press **OFrame Review** on the CINE LCD.

   The system displays the CINE indicator in the lower right of the image screen.

3. Roll the trackball to the left or right to review individual frames.

   The CINE indicator identifies the location of the current frame within the CINE data.

   Note: For motion modes (M or Doppler), one frame of time motion data is displayed at a time. No frame numbers are displayed.

4. To exit and clear the memory, press the **FREEZE** key.

   The system activates real-time imaging.

Motion Review

The Motion Review method provides continuous display of CINE data in a forward direction. When Motion Review is active, the CINE LCD displays the **◯Rate** LCD key for adjusting the review speed.

To review CINE data using the Motion method:

1. Activate CINE.

2. Press **◯Motion Review** on the CINE LCD.

    The system begins a forward, continuous display of the CINE data at the frame rate at which it was acquired. This frame rate displays next to the **FPS** field on the upper left of the image screen.

3. To exit and clear the memory, press the **FREEZE** key.

    The system activates real-time imaging.

Adjusting the Review Speed

During Motion Review, increase or decrease the review speed using either the CINE **◯Rate** LCD selection or the **SELECT-L** control.

The maximum review speed is the frame rate (1/1). Other selections are: 1/2, 1/4, and 1/8 of the frame rate.

Note: The signal of a Doppler spectrum is not audible when the review speed has been adjusted.

To adjust the review speed:

▪ Press **◯Rate** or rotate the **SELECT-L** control to cycle through the available frame rates.

    The system updates the review speed of the CINE data on the LCD.

Editing the Loop

You can change the beginning and ending CINE Review positions within a loop of data. This edit function allows you to exclude frames from review of a specific segment. Exiting the CINE function will reset both points.

94

Markers indicate the edited segment of CINE data using ○**Edit Start** *and* ○**Edit End** *LCD selections.*

To change the beginning position:

1. Activate CINE.

2. Press ○**Frame Review** on the CINE LCD.

3. Roll the trackball to advance the starting position of the CINE data, one frame at a time.

   The system repositions the marker on the CINE indicator representing the beginning position.

4. Press ○**Edit Start** on the CINE LCD to lock the marker for the edit beginning point.

5. To review the edited CINE data, select ○**Motion Review** on the CINE LCD.

To change the ending position:

Note: The end point for the CINE data cannot be moved ahead of the start point.

1. Activate CINE.

2. Press ○**Frame Review** on the CINE LCD.

3. Roll the trackball to advance the ending position of the CINE data, one frame at a time.

   The system repositions the marker on the CINE indicator representing the ending position.

4. Press ○**Edit End** on the CINE LCD to lock the marker for the edit ending point.

5. To review the edited CINE data, select ○**Motion Review** on the CINE LCD.

To reset the beginning and ending positions:

▪ With Frame Review active during CINE, press ○**Edit Reset** on the CINE LCD.

   Edited beginning and ending positions are deleted.

Dual CINE

While operating in 2D Dual-mode or 2D Dual-mode with color, the system divides the CINE memory buffer into two equal parts to provide image recording. During 2D Dual-mode or 2D Dual-mode with color, you can acquire two independent single 2D-mode images or two independent single 2D-mode with color image loops. The loops display simultaneously side-by-side. Each loop is also available for individual replay.

Note: In Dual-mode, both images must be in 2D-mode, or the active image can be in 2D-mode with color while the inactive image is in 2D-mode. Both images cannot be in 2D-mode with color at the same time.

[2] Instructions for Use

Dual-mode   Ch A2

Reviewing and Synchronizing Dual-Mode Images

When set to **On**, the **◑Align** LCD selection synchronizes the CINE display of the two 2D images during Dual-mode. The system displays the **◑Align** LCD selection during Frame Review and Motion Review.

To review CINE data in Dual-mode:

1. After acquiring and freezing images in Dual-mode, activate CINE.

    The last active image in Dual-mode is the image under CINE Review.

2. Press one of the **DUAL/SELECT** keys to select the active image under CINE Review.

3. To synchronize the images, press the **◑Align** LCD key to select the **On** setting.

    The CINE indicator displays in the lower right of both Dual-mode images.

    Note: While in Motion Review, each ECG-triggered data loop must be displayed along with the associated ECG trace, the image data, and the ECG trace synchronized. This requirement is for both loops (Dual images).

4. Roll the trackball to the left or right to review the two images simultaneously.

CINE with Doppler

Note: The 2D-mode image is frozen and does not update with the Doppler spectrum.

During **Frame Review**, the spectrum is played back frame by frame. You can roll the trackball to scroll the spectrum, one frame at a time, in either direction.

During **Motion Review**, the spectrum is played back in a forward, continuous direction. Doppler spectrums and audio signals are audible during CINE review only with Motion Review. For the signal to be audible, the review speed must match the original acquisition speed.

To access full-screen CINE data with 2D-mode/Doppler or 2D/M-mode:

1. Activate CINE.

2. Press the right **DUAL/SELECT** key to access a full-screen CINE Doppler spectrum or M-mode sweep.

3. Press the left **DUAL/SELECT** key to access a full-screen CINE 2D-mode image.

    You can alternate pressing the right and left keys to toggle full-screen images.

4. Roll the trackball to perform a Frame Review or select **OMotion Review** on the CINE LCD for either full-screen image.

5. Press either **DUAL/SELECT** key a second time to return to the normal split-screen format.

To toggle 2D-mode and Doppler/M-mode CINE data:

Note: This procedure applies only to data acquired simultaneously (using the **TRIPLEX** key).

1. Activate CINE.

2. Press the **UPDATE** key to activate 2D-mode CINE data review or Doppler/M-mode CINE data review.

3. Roll the trackball to perform a Frame Review or select **OMotion Review** on the CINE LCD for the active image.

Interacting with Other Functions

ECG Display and Trigger

During CINE Review, a marker above an ECG trace indicates the segment of the heart cycle that corresponds to the currently displayed image.

To display the ECG Trigger with CINE Review:

1. Place the ECG trigger along the ECG trace on the real-time image.

2. After acquiring images, press the **FREEZE** key and then activate CINE Review by pressing the **CINE** key.

   The system waits until the delay time of the Trigger position, then starts acquiring CINE frames and continues until CINE memory is full.

   When the CINE memory is filled, the system freezes the image and the data is available for CINE Review. The system displays the CINE indicator.

   If you press the **FREEZE** key quickly after the first Freeze command, the system will freeze without gathering a full CINE memory buffer. The acquired data will still be available for review.

Image Magnification

Use the **DEPTH/ZOOM** control to magnify a single frame of CINE data. You can also display images in CINE Review that were acquired while using the Zoom function, but the magnification cannot be reduced on those images.

Video Recording

You can record data from CINE memory to a VCR or video recording device connected to the ultrasound system.

- Press the **VCR** key on the control panel while a single frame or image is displayed.

CINE Review Post-Processing

You can apply the following post-processing functions to CINE data in either Frame Review or Motion Review.

Note: Rotate the **FUNCTION SELECT** control on the LCD panel to activate tabs for different imaging modes.

- Colorization of 2D-mode images, M-mode sweep, or Doppler spectrum using the **◯Color** LCD selection

- 2D-mode LCD selections for: **◯A-mode**, **◯Offset**, **◯Gray Map**, **◯Reject**

- 2D-mode with color LCD selections: **◯Vel Tag, ◯Color Map**

- Doppler LCD selections: **◯Reject**, **◯Post Process** and the automatic trace options of **◯Trace Mode**, **◯Trace Mean**, **◯Trace Min**, and **◯Trace Max**

- Addition of Annotation and Pictograms

- Use of Measurement and Calculation packages, including the Report/Worksheet

- Changes in Image Orientation using the **L/R** and **ROTATE** keys

- Magnification of the Image using the **DEPTH/ZOOM** control

- Storage of Images using the **DIGITAL STORE** key and recording to an optionally connected video recorder

To access CINE Review after post-processing CINE data:

- Rotate the **FUNCTION SELECT** control on the LCD panel to select the **CINE** tab.

  The system displays LCD selections for CINE Review, while the CINE data retains the post-processing modifications.

To exit CINE Review after post-processing CINE data:

- Press the **FREEZE** key after post-processing CINE data.

  CINE memory is cleared and begins filling with new data.

A6 Biopsy

Biopsy (Puncture) Guideline Function

⚠ **WARNING:** Percutaneous procedures always involve heightened risk to the patient and to the operator handling biopsy needle guides. Clinicians using Siemens recommended biopsy devices under ultrasound guidance should be trained and must observe proper needle insertion sequencing with the needle guide in order to avoid undue discomfort and unnecessary risk and injury to the patient.

⚠ **WARNING:** The biopsy guidelines that display on the system monitor are not intended as an absolute reference. It is the user's responsibility to verify correct positioning of the needle during a biopsy or puncture procedure.

You can display on-screen guidelines for use with transducers compatible with needle guide attachments.

The Biopsy function is available during real-time imaging in the following modes and mode formats:

- 2D-mode
- 2D-mode with color
- Dual-mode (guidelines are on the active image)
- Split-mode
- Zoom (guidelines track to the zoomed image)
- Offset (guidelines track to the offset image)

Activating the Guideline Function

The ultrasound system has several options for customizing the guidelines for use with a biopsy or puncture procedure. These options are located on the LCD when you activate the Biopsy function.

Use the system presets to enable the Biopsy function to automatically activate when an exam type is selected.

To initiate the Guideline function:

1. Press the **F13** key on the keyboard, or select **OBiopsy** from the transducer LCD menu (accessed by pressing the **TRANSDUCER** key on the control panel). If you enabled an exam type to activate the Biopsy function when selected, select that exam type.

   The system displays this message as a precaution:

   Caution: Verify needle path and scale prior to Biopsy. Select the OK button to continue.

2. Select the **OK** button.

   The system automatically detects the active transducer and displays the corresponding LCD options for the guideline function with the **OGuide** selection set to **On**. If necessary, rotate the **FUNCTION SELECT** control on the LCD panel to select the **Bio** tab and display the Biopsy LCD selections.

3. Before performing any patient procedure, verify the needle path.

4. To exit the function, press the **F13** key on the keyboard, or press the **2D** or **ESC** key on the control panel.

System Reference

System Presets   Ch 3

▤
F4

Default Settings
▶ Biopsy

Modifying the Display of Guidelines

The **ⵔDisplay cm** and **ⵔDot Interval** selections on the Biopsy LCD offer options to include (or remove) centimeter markings along the guidelines and to select the dot size representing the guidelines.

To display or remove centimeter depth markings along the guideline:

1. If the selections for the guideline function are not currently on the LCD, press the **F13** key on the keyboard. If necessary, rotate the **FUNCTION SELECT** control on the LCD panel to select the **Bio** tab and display the Biopsy LCD selections.

2. Select **ⵔDisplay cm** to toggle the depth marking display options.

    On — displays centimeter depth numbers.

    Off — does not display centimeter depth numbers.

To determine the dot size representing the guidelines:

1. If the selections for the guideline function are not currently on the LCD, press the **F13** key on the keyboard. If necessary, rotate the **FUNCTION SELECT** control on the LCD panel to select the **Bio** tab and display the Biopsy LCD selections.

2. Select **ⵔDot Interval** to toggle the dot size options.

    10 – the system displays dots representing guidelines at 10 mm intervals.

    5 – the system displays dots representing guidelines at 5 mm intervals.

Needle Path Verification

Before performing any patient procedure using a needle guide, you must verify that the path of the needle is accurately indicated by the on-screen guidelines.

The needle guide is ready for patient use *only after the path of the needle has been verified*.

Checklist of Items Required for Needle Path Verification

☐ Transducer with attached needle guide

☐ Water-based coupling agent (gel)

☐ Sterile transducer cover

☐ New, straight, biopsy needle

☐ Sterilized container of sterilized and degassed water

To verify the path of the needle:

⚠ **WARNING:** The biopsy guidelines that display on the system monitor are not intended as an absolute reference. It is the user's responsibility to verify correct positioning of the needle during a biopsy or puncture procedure.

⚠ **WARNING:** Do not use a needle guide if the path of the needle is not accurately indicated by the on-screen guidelines. The path of the needle must display within the guideline. Contact your Siemens service representative if the needle path is not accurately indicated.

1. Attach the needle guide to the transducer.

2. Connect the transducer to the system and activate the transducer.

3. Set the system to the depth of the intended puncture procedure.

4. Press the **F13** key on the keyboard to display the guidelines on-screen. If necessary, rotate the **FUNCTION SELECT** control on the LCD panel to select the **Bio** tab and display the Biopsy LCD selections.

5. Immerse the head of the transducer into the degassed water and insert the needle into the needle guide.

6. Verify that the path of the needle displays according to the guidelines shown on the image screen.

7. After verification, the needle guide is ready for use.

Adjusting the Guidelines

You can finely adjust the position of guidelines using the
OAngle Adjust Biopsy LCD selection.

To adjust the guidelines:

⚠ **WARNING:** Do not use a needle guide if the path of the needle is not
accurately indicated by the on-screen guidelines. Contact your Siemens service
representative if the needle path is not accurately indicated.

1. If the selections for the guideline function are not currently on the LCD,
   press the **F13** key on the keyboard. If necessary, rotate the
   FUNCTION SELECT control on the LCD panel to select the **Bio** tab
   and display the Biopsy LCD selections.

2. Select **OAngle Adjust** on the Biopsy LCD to incrementally change the
   position of the guidelines. The range of adjustment is +/- 8 degrees in
   0.1°increments.

   The path of the needle must display within the guidelines.

To reset the guidelines to the factory-default position:

▪ Select **OReset Angle** on the Biopsy LCD to restore the original position
   of the guidelines.

A7 ECG

ECG Function

(Requires the Cardiac Imaging option.)

The ECG function includes an ECG cable and three leads, along with a start-up kit of ECG electrode patches.

⚠ **WARNING:** Do not use the ECG option in conjunction with electrosurgery or diathermy equipment.

⚠ **WARNING:** Use ECG for timing purposes only. It is not intended for diagnostic usage or patient monitoring.

The ECG trace is used to place ***triggers***, or timing markers, which update the 2D-mode image at specific point(s) in the cardiac cycle. The electrical activity controlling the heart muscle is detected by placing ECG electrode patches in specific locations on the patient and amplifying the electrical signals that produce the ECG trace display on the system monitor.

EMC Note: Operating the ultrasound imaging system in close proximity to sources of strong electromagnetic fields, such as radio transmitter stations or similar installations may lead to interference visible on the monitor screen. However, the device has been designed and tested to withstand such interference and will not be permanently damaged.

Connecting ECG Cables and Leads

⚠ **WARNING:** To reduce risk of electric shock and burns, use only the cable and patient leads supplied with the ECG option. Use of other ECG cables could defeat the current-limiting and electrical safety features of the ECG.

The following procedure describes how to connect the ECG cable and leads to the ultrasound system for use with the ECG function.

To connect the ECG cable:

▪ Connect the six-pin ECG cable to the socket labeled "ECG" on the front of the system.

⚠ **Caution:** To avoid possible damage to the ECG cables, do not pull on the cables when disconnecting the ECG connector. Always grasp the connector housing.

Connecting Leads to the Patient

ECG leads are color coded and labeled according to regional standards. Siemens offers two different ECG lead options.

For 115V systems, Siemens ships ECG leads complying with the ANSI/AAMI EC53-1995 standard. For 230V systems, Siemens ships ECG leads complying with the IEC 601 standard.

ECG Patch	ANSI/AAMI EC53-1995		IEC 601	
Location	Color Code	Label	Color Code	Label
Left leg	Red	LL	Green	F
Right arm	White	RA	Red	R
Left arm	Black	LA	Yellow	L

Only use ECG leads that comply with the requirements of your country.

To connect the leads to the patient:

1. Attach the ECG electrode patches to the patient in the locations specified above.

2. Connect each lead to the appropriate patch.

ECG connector socket.

Using the External ECG Cable

⚠ **WARNING:** The Aux 1 ECG input is not intended for direct connection to the patient. To reduce the risk of electrical shock while using this connection, ensure that the external source (peripheral equipment) is properly set up and is designed for direct patient connection.

The following procedure describes how to connect the external ECG cable to the ultrasound system for use with the ECG function.

To connect the external ECG cable:

1. Connect the one-pin external ECG cable to the socket labeled "Aux 1 ECG" on the front of the system.

2. To connect the external ECG cable to a device (external source), see the device manufacturer's operating instructions.

Activating the ECG Function

The ECG function is activated and the ECG trace is displayed when you press **⊙On/Off** on the ECG LCD. The trace pattern displays on the image screen and scrolls from left to right.

Use the system presets to automatically activate the ECG function when an exam type is selected.

To display an ECG trace:

1. If necessary, rotate the function select control on the LCD panel to select the **ECG** tab and display the ECG LCD selections.

2. Press **⊙On/Off** on the ECG LCD to activate the ECG function after connecting the ECG cable to the system and the ECG leads to the patient.

3. If you are using an external ECG cable, press **⊙External** on the ECG LCD to activate the external ECG function. The system displays the ECG trace on the image screen.

4. Press the **⊙On/Off** LCD selection a second time to remove the trace.

Note: If baseline wander in the ECG trace becomes a problem, the cause may be respiratory movement (ventilatory excursions). Minimize this artifact by making certain that the ECG leads or cable are not needlessly draped over the patient. Secure the leads and cable off to the side of the patient.

Aux 1 ECG

Aux 1 ECG connector socket.

Activating the Trigger Function

During 2D-mode and Split (B+B) mode imaging, you can enable one or two trigger markers for positioning at specific points in the cardiac cycle. Each trigger defines when the system updates (refreshes) the 2D image. Each trigger displays as a red segment of each cycle of the ECG trace.

Note: If you enter M-mode or Doppler from 2D-mode imaging, the system deactivates the trigger function. If you reenter 2D-mode imaging, reactivate the trigger function.

To enable trigger(s):

1. If necessary, rotate the function select control on the LCD panel to select the **ECG** tab and display the ECG LCD selections.

2. Activate the ECG function.

   The system displays the ECG trace on the image screen, at the vertical location determined by the **◐Position** LCD selection.

3. Press **◐Trigger** on the ECG LCD to activate the trigger function.

4. Press **◐Single** on the ECG LCD to select either one or two triggers.

   The triggers display as red segments of the ECG trace. The image is refreshed at the position(s) of the trigger(s), which each indicate a point in the cardiac cycle. If Split (B+B) Mode is active, each 2D image is refreshed at the position(s) of the trigger(s).

5. To reposition the first (or single) trigger, press **◐CH1 Delay** on the ECG LCD.

   Each press of the LCD selection visibly advances the position of the trigger by ten milliseconds.

6. To reposition the second trigger, press **◐CH2 Delay** on the ECG LCD.

   Each press of the LCD selection visibly advances the position of the trigger by ten milliseconds.

Setting the Trigger Delay

Use a trigger delay to evaluate the function of the valves, wall motion, and dynamics of blood flow. This delay relates the 2D-mode image to the specific phases of the ECG. Use the **⭕CH1 Delay** and **⭕CH2 Delay** LCD selections when the ECG function is active to select the point(s) in the cardiac cycle at which the system updates the 2D image.

The **⭕CH1 Delay** and **⭕CH2 Delay** ECG LCD selections each range from 0 to 990 milliseconds.

Note: When you change a trigger delay, a "lag" period occurs before the new trigger position is activated.

When the ECG function is turned off and back on, the system retains the "last known" position(s) of the trigger(s).

To position the first (or single) trigger when the trigger function is activated:

1. If necessary, rotate the function select control on the LCD panel to select the **ECG** tab and display the ECG LCD selections.

2. Press **⭕CH1 Delay** on the ECG LCD.

   Each press of the LCD selection visibly advances the position of the trigger by ten milliseconds.

To position the second trigger when the trigger function is activated and two triggers have been selected:

1. If necessary, rotate the function select control on the LCD panel to select the **ECG** tab and display the ECG LCD selections.

2. Press **⭕CH2 Delay** on the ECG LCD.

   Each press of the LCD selection visibly advances the position of the trigger by ten milliseconds.

Note: If you select two triggers and the triggers have identical values, then the system derives the second update time from the frame rate. For example, if the **⭕Single** ECG LCD selection is set to **Dual**, the **⭕CH1 Delay** and **⭕CH2 Delay** ECG LCD selections are both set to **300**, and the frame rate is five seconds, then the system updates the 2D image at 300 and 500 milliseconds – 300-millisecond intervals for the first trigger, and 200 milliseconds after each first-trigger update for the second trigger. (The update time for the second trigger is derived by dividing 1000 milliseconds, or one second, by the frame rate. In this example, 1000 milliseconds divided by 5 frames-per-second is 200 milliseconds.) If you then change the **⭕CH2 Delay** ECG LCD selection to **310**, then the system updates the 2D image at 300 and 310 milliseconds.

ECG Troubleshooting Guide

Symptom	Possible Cause
ECG trace is not present, or cannot detect an R-wave	❐ The ECG cable is not properly attached to the system.
	❐ Leads are poorly connected to the cable.
	❐ Leads are poorly connected to the patient.
	❐ Leads are incorrectly placed on the patient. Remove the ECG patch, clean the skin, and attach a new ECG patch to the patient.
	❐ ECG gain is set too low. Select **OGain** on the LCD to increase the gain.
Cannot position a trigger	❐ No R-wave present (see above).
	❐ Too much movement by the patient.
ECG trace is noisy, ragged, or erratic	❐ ECG gain is set too high. Select **OGain** on the LCD to decrease the gain setting.
	❐ A lead or leads may be detecting muscle movement. Inspect the ECG patch placement and reposition the lead(s) on the patient as necessary.
	❐ The conductive gel pad of an ECG patch has evaporated (dried out). Replace the ECG patch with a new one (check the expiration date of the new patch).
Trigger is not visible on the trace	❐ A trigger may be superimposed on the R-wave.
	❐ If dual triggers are used, the first and second trigger may be superimposed. Select **OCH1 Delay** or **OCH2 Delay** on the ECG LCD to reposition a trigger.

Potential ECG Error Messages

Message on the Image Screen	Possible Cause
Erratic ECG detected. Please check ECG leads.	❐ Leads are poorly connected to the patient. Remove the ECG patch, clean the skin, and attach a new ECG patch to the patient.
	❐ Too much movement by the patient.

A8 Stress Echo

About the Stress Echo Feature

The optional Stress Echo feature allows you to capture and review cardiac loops for multiple-phase (multiple-stage) Stress Echo protocols. It provides tools for ECG-triggered acquisition, display, selection, comparison, evaluation, and archiving of multiple cardiac loops during various stages of the Stress Echo portion of a patient examination. Archival and retrieval of **Stress Echo data** is accomplished through DIMAQ-IP.

Stress Echo data consists of Stress Echo loops, wall motion scores, LV volume measurements, and all other information pertaining to the Stress Echo portion of a patient examination.

Acquisition of Stress Echo Loops

Acquisition begins during a Cardiac patient examination when you press the **CALIPER** key after protocol selection and ends when you indicate that no more image acquisition is needed. Throughout acquisition, the system acquires images according to the number of **loops** per **view** that is configured in the **Protocol Editor** dialog box for each **phase** in the protocol.

Loops, views, and phases are components of a protocol. For example, the default **Treadmill** protocol has a **Rest** and a **Post** phase, each with four views (**A4C**, **A2C**, **PLAX**, **PSAX**). The default configuration for the **Treadmill** protocol sets image acquisition to four loops per view for both phases. A loop is a clip that displays motion from beginning systole to end systole (end diastole to end systole), as indicated by the R-wave of the ECG trace and determined by the **QT – Time Table** in the **Maintenance** dialog box.

Although the system acquires images throughout acquisition, the system saves images only when a view is selected and you press the **CALIPER** key. For example (under default settings), if you select the **A4C** view of the **Rest** phase in the **Treadmill** protocol and then press the **CALIPER** key to save acquired images, the system saves the previous four acquired loops and labels each loop "A4C–Rest". (Labels are visible in the Stress Echo screen.)

Use the system presets to enable the ECG function to automatically activate when the Cardiac exam type is selected.

▪ For an alternative workflow, you can configure stages in Stress Echo protocols using the **continuous** option. Loops in continuous stages are limited by time rather than a maximum number of loops—the system stops acquisition after two minutes. Acquisition is prospective; when you select the stage label and then press the **CALIPER** key, the system starts saving newly acquired images. With this workflow, you assign view labels to the loops after acquisition is complete, using controls in the Stress Echo screen to select the "preferred" loop for each view.

   Note: For continuous stage loops, you must assign view labels to use the wall motion scoring and left ventricle measurement functions in the Stress Echo screen.

▪ The system has default protocols containing continuous stages (continuous capture stages).

▪ You can suspend Stress Echo acquisition to use another imaging mode, such as 2D-mode or Doppler imaging. You can later reactivate Stress Echo to complete the suspended protocol.

When you save images, the system places a green checkmark to the left of the view or continuous stage and then shifts the red arrow to the next view or continuous stage. When image acquisition is completed for the first stage, the system displays a reference image of the corresponding view from the first stage (if the stage is non-continuous and if reference image display is enabled).

To acquire Stress Echo loops:

Note: To acquire Stress Echo loops that are based on the systolic cycle, enable the ECG option in system presets. If this option is not enabled, the system acquires one-second clips by default. ECG must be enabled for continuous stages.

Note: The term "phase" and the term "stage" are used interchangeably.

1. Begin a patient examination with the **Cardiac** exam type.

2. Press the **CRESCENDO** key on the control panel.

3. If multiple Crescendo applications are installed, select **OStress Echo** from the LCD.

    The system displays the **Select Protocol to load** window with protocol selections.

4. Select the protocol and then select **OK**.

    The system displays the real-time imaging screen.

    If the Stress Echo manual ROI option is selected in the Maintenance dialog box, then the system also displays a region of interest (ROI).

5. If an ROI is displayed, adjust the ROI size and position if required.

    Note: You cannot adjust the ROI size during acquisition.

6. Press the **CALIPER** key on the control panel to start acquisition.

    The system displays the Protocol window on the left of the screen, listing the phases for the selected protocol along with the views of the first phase. The system selects the first view for acquisition, indicating view selection by placement of a red arrow to the left of the view.

7. Proceed through each view in each stage using the following
    instructions (for non-continuous stages):

    –   To save acquired images for the selected view, press the
        CALIPER key on the control panel.

        The system places a green checkmark to the left of the selected
        view and then shifts the red arrow to the next view. If all views have
        acquired images, then the system shifts the red arrow to the
        Stop selection.

    –   To skip the selected view, press the **ESC** key on the control panel.

        The system shifts the red arrow to the next view. If all views have
        acquired images, then the system shifts the red arrow to the
        Stop selection.

    –   To select a view for image acquisition (or reacquisition), position the
        trackball pointer over the view and then press the **SET** key on the
        control panel.

        The system shifts the red arrow to the selected view.

    –   To replace saved images (save newly acquired images) for the
        selected view, press the **CALIPER** key.

        The system places a green checkmark to the left of the selected
        view and then shifts the red arrow to the next view that has no
        acquired images. If all subsequent views have acquired images,
        then the system shifts the red arrow to the **Stop** selection.

    –   To start the timer, press the **UPDATE** key on the control panel.

        The system displays the timer at the top of the Protocol window.
        Each saved image is marked with the number of seconds indicated
        on the timer. The timer stops at the end of each phase.

    –   To restart the timer for a new phase, press the **UPDATE** key on the
        control panel.

        The displayed timer at the top of the Protocol window restarts from
        zero seconds. Each saved image is marked with the number of
        seconds indicated on the timer. The timer stops at the end of
        each phase.

    At completion of acquisition for each stage, the system advances to the
    next stage. If the stage is non-continuous, then the system displays the
    views of the stage. When image acquisition is completed for all views
    and continuous stages, the system shifts the red arrow to the **Stop**
    selection in the Protocol window.

8. If the protocol contains continuous stages (for alternative workflow), then proceed through each continuous stage using the following instructions:

   – To begin saving acquired images for the selected stage, press the **CALIPER** key on the control panel.

     The system displays a percentage marker below the selected stage indicating the progress of the continuous capture.

   – To stop saving acquired images for the selected stage (before the system automatically completes the continuous capture), press the **CALIPER** key again.

     The system replaces the percentage marker with a **continuous** label.

   – To skip the selected stage, press the **ESC** key on the control panel.

   – To select another continuous stage, position the trackball pointer over the stage and then press the **ENTER** key on the control panel.

   At completion of acquisition for each stage, the system advances to the next stage. If the stage is non-continuous, then the system displays the views of the stage. When image acquisition is completed for all views and continuous stages, the system shifts the red arrow to the **Stop** selection in the Protocol window.

9. To adjust the ROI position during acquisition, press the **SELECT** key on the control panel and then roll the trackball until you achieve the required ROI position. Press the **SELECT** key again to continue acquiring Stress Echo loops.

10. To review loops before ending acquisition, press the **REVIEW** key on the control panel. You can redisplay the real-time imaging screen to continue acquisition by pressing the **REVIEW** key again or by selecting the **Acquire Mode** toolbar button at the top of the screen.

    Note: You can press the **REVIEW** key when a continuous stage is selected for acquisition. The system saves the images acquired in the buffer (indicated by the percentage marker displayed below the selected stage) before displaying the Stress Echo screen.

11. To end acquisition and review the acquired images, position the trackball pointer over the **Stop** selection (if this selection is not already highlighted) and then press the **CALIPER** key.

    The system displays the Stress Echo screen with **LV Mode** automatically enabled. The patient information at the top of the screen indicates the time and date of patient registration.

To suspend Stress Echo acquisition for use of another imaging mode:

1. Press the **STRESS ECHO** key on the control panel.

2. To use another imaging mode, press the required control (such as **D**) on the control panel.

3. To reactivate the suspended Stress Echo acquisition:

   a. Press the **STRESS ECHO** key again (and select **OStress Echo** from the LCD if required) and then select the **[Suspended]** protocol from the **Select Protocol to load** window.

      The system displays the real-time imaging screen.

      If the Stress Echo manual ROI option is selected in the **Maintenance** dialog box, then the system also displays a region of interest (ROI).

   b. If an ROI is displayed, adjust the ROI size and position if required.

      Note: You cannot adjust the ROI size during acquisition.

   c. Press the **CALIPER** key on the control panel.

   The system displays the **Protocol** window on the left of the screen, listing the phases for the selected protocol along with the views of the current phase. (Phases are stages.) The system reselects the view that was selected when the Stress Echo acquisition was suspended, indicating view selection by placement of a red arrow to the left of the view.

Recording Stress Echo Data

You can record Stress Echo data to video recording media. Use the **VCR** key to send examination data to a video recording device.

Use the system presets to configure the **VCR** key and to display the playback code.

To record patient data using a video recording device:

- Insert the media into the video recording device and then press the **VCR** key on the control panel to begin recording.

Review of Stress Echo Data

The system displays Stress Echo data in the Stress Echo screen. Stress Echo data consists of Stress Echo loops, wall motion scores, LV volume measurements, and all other information pertaining to the Stress Echo portion of a patient examination.

Using the Stress Echo screen, you can select preferred loops, compare (review) loops, designate phases and views for display, assign wall motion scores, and measure left ventricular volume. You can choose from several loop playback options.

You can save Stress Echo data with either all acquired loops or just the preferred loops. After you save data, the Stress Echo screen remains displayed until you exit the Stress Echo feature.

Each loop is identified by a sequence identifier number. ***Sequence identifier numbers*** indicate the sequence of loop acquisition within the view.

Use the system presets or the Stress Echo screen to access the Maintenance dialog box and display sequence identifier numbers.

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Customize Keys
▶ VCR/DVD key
Display
▶ Playback Code

System Reference

Archiving and
  Copying Studies   Ch 5

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Stress Echo
▶ Frame slider

Accessing the Stress Echo Screen

You can review acquired Stress Echo data before or after acquisition is completed. You can also review previously saved Stress Echo data. Stress Echo data is displayed in the Stress Echo screen.

To review Stress Echo data during acquisition:

1. Press the **REVIEW** control on the control panel.

    The system displays the Stress Echo screen with **Select Mode** enabled. In this mode, the system displays the default loop selection for each view.

    Note: For views in continuous stages, there are no default loop selections.

2. Press the **REVIEW** control on the control panel or select the **Acquire Mode** toolbar button at the top of the screen.

    The system removes the display of the Stress Echo screen and redisplays the real-time imaging screen.

Select Mode
toolbar button.

Acquire Mode
toolbar button.

To complete acquisition and review Stress Echo data during the patient examination:

▪ Select the **Stop** selection on the Protocol window to indicate that acquisition is complete.

The system displays the Stress Echo screen, with **LV Mode** enabled.

To review previously saved Stress Echo data:

Note: Saved Stress Echo data cannot be retrieved from CDs. To review this data, copy the study to the system's hard disk.

1. Press the **REVIEW** control on the control panel.

2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.

The system displays the Study screen.

3. Select the study and then select the **Image Screen** button on the right of the screen.

The system displays the images that are saved in the selected study. Stress Echo data is represented as a single image with a Stress Echo symbol located on the upper right of the image.

4. Select the Stress Echo symbol on the upper right of the image displayed in the DIMAQ-IP Image screen.

The system displays the Stress Echo screen with **Review Mode** enabled. In this mode, the system displays the previously selected "preferred" loop for each view. (If no "preferred" loop was selected for a view, then the system displays the default loop selection.) Previously saved LV measurements and Wall Motion Scores are also available. If all acquired loops were saved with the Stress Echo data, then you can view all loops for each view by selecting **Select Mode**.

Note: For views in continuous stages, there are no default loop selections. The system displays only the previously selected "preferred" loops for views in continuous stages.

The Stress Echo symbol is displayed on the image that represents Stress Echo data.

Selecting Preferred Stress Echo Loops

In **Select Mode**, you can select the representative loop ("preferred" loop) for each view. If you activate **Review Mode** without first selecting preferred loops, then the system uses the ***default loop selection*** to represent each view. The default loop selection is the loop acquired immediately prior to the last loop. For example, if four loops are acquired for every view, then the default loop selection is the third loop.

Note: Loops for views in non-continuous stages are labeled with the view name at acquisition. Loops for views in continuous stages are labeled with the view name when you select the "preferred" loop.

Each loop is identified by a sequence identifier number. ***Sequence identifier numbers*** indicate the sequence of loop acquisition within the view.

Use the system presets or the Stress Echo screen to access the Maintenance dialog box and display sequence identifier numbers.

To activate Select Mode from the Stress Echo screen:

▪ Select the **Select Mode** toolbar button at the top of the screen.

To select "preferred" loops:

1. Activate **Select Mode**.

   The system displays the acquired loops for the first view in the protocol (for non-continuous stages). If the first stage is continuous, then the system displays the first set of acquired loops for that stage.

2. Select the loop.

   The system outlines the selected loop in yellow to indicate selection and then automatically displays the loops for the next view.

3. Continue designating the "preferred" loop for each displayed view until all views are completed.

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Stress Echo
▶ Frame slider

Select Mode
toolbar button.

Displaying Views and Loops in Select Mode

Use the buttons displayed during Select Mode to designate another loop or another view for display.

To display another loop in the current view:

▪ Select one of the following buttons on the right of the screen:

Note: For a continuous stage, the **Home**, **To Left**, **To Right**, and **End** buttons display loops saved for the stage (not the view).

 – **Home** – displays the first loop

 – **To Left** – displays the previous loop

 – **To Right** – displays the next loop

 – **End** – displays the last loop

To display another view:

▪ Select one of the following buttons on the right of the screen:

Note: For a continuous stage, the **Scroll Up** and **Scroll Down** buttons display the preferred loop for the view. If no loop is designated as preferred for the selected view, then these buttons have no effect.

 – **Scroll Up** – displays loops in the previous view

 – **Scroll Down** – displays loops in the next view

Home button.

To Left button.

To Right button.

End button.

Scroll Up button.

Scroll Down button.

Reviewing and Comparing Stress Echo Loops

During **Review Mode** and **Wall Motion Scoring Mode** you can compare views by phase or display all phases for a view. You can designate which phases and/or views are displayed. You can also display the representative loop for a view in full-screen format.

Note: Only one of the following buttons can be activated at a time: **Shuffle Mode** or **Display Selected Loops**.

To activate Review Mode from the Stress Echo screen:

- Select the **Review Mode** toolbar button at the top of the screen.

Review Mode toolbar button.

To activate Wall Motion Scoring Mode from the Stress Echo screen:

- Select the **Wall Motion Scoring Mode** toolbar button at the top of the screen.

Wall Motion Scoring Mode toolbar button.

To restrict the display to a selected phase or view:

1. Select the **Shuffle Mode** button on the right.

2. Select the label of the phase or view (for example, **Rest** or **Long Axis**).

   The system displays all loops that represent the selected phase or view.

Shuffle Mode button.

To display phases side by side for the selected view(s):

1. To include a phase or view in display, select the leftmost, gray box to the left of each required phase and/or view.

   The system inserts a checkmark into each selected gray box.

2. To exclude a phase or view from display, select the rightmost, blue box to the left of each required phase and/or view.

   The system inserts a red X into each selected blue box.

3. Select the **Display Selected Loops** button on the right.

   The system displays selected phases for each selected view side by side.

Display Selected Loops button.

To display all views for a specific phase:

▪ Select the phase label (for example, **Rest**).

To display all phases for a specific view:

▪ Select the view label (for example, **Long Axis**).

The system displays all phases for the selected view. If fewer than four phases exist, then the system also displays phases for the next view.

To display a loop in full-screen format:

1. Select the loop to activate it.

The system outlines the loop in yellow to indicate activation.

2. Select the loop again.

The system displays the loop in full-screen format.

3. To display the loop in its initial size, select the loop again.

Playing Back Loops

You can play back loops in the Stress Echo screen. By default, the system plays back loops in the forward direction only, from beginning systole to end systole (end diastole to end systole). You can play back the loops in both directions, forward from beginning systole to end systole and then reversed from end systole to beginning systole. You can change the speed of playback and you can display a specific frame.

To playback the displayed loops:

1. Select (highlight) the **Toggle Play** toolbar button at the top of the screen.

   The system plays the displayed loops in one direction, from beginning systole to end systole. When the last frame is played, the system restarts playback from the first frame.

2. To stop playing the displayed loops, select the **Toggle Play** toolbar button again.

To playback the displayed loops in both directions (from diastole to systole and then back to diastole):

- Select (highlight) the **Sweeping Play** toolbar button at the top of the screen.

   The system initially plays the displayed loops in one direction, from beginning systole to end systole. When the last frame is played, the system reverses the playback direction, playing the displayed loops from end systole to beginning systole.

To change the playback speed:

- Select the **Decrease Speed** toolbar button or the **Increase Speed** toolbar button at the top of the screen.

To display a specific frame in the loops:

- Select one of the following toolbar buttons at the top of the screen:
  - **Start of Sequence** – displays the first frame of each loop
  - **Step Backward** – displays the previous frame of each loop
  - **Step Forward** – displays the next frame of each loop
  - **End of Sequence** – displays the last frame of each loop

Toggle Play
toolbar button.

Sweeping Play
toolbar button.

Decrease Speed
toolbar button.

Increase Speed
toolbar button.

Start of Sequence
toolbar button.

Step Backward
toolbar button.

Step Forward
toolbar button.

End of Sequence
toolbar button.

Excluding Frames from Review

You can exclude frames from review by selecting loop segments for display or by repositioning the review markers on the loop bar. You can reposition review markers for one loop or for all loops.

The **loop bar** indicates the location of the displayed frame and the beginning and ending review positions within the loop.
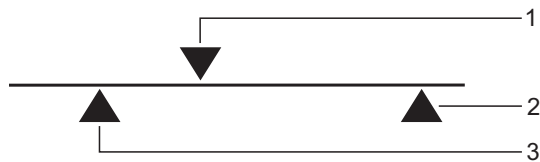
Example of loop bar.

1 **Frame indicator** – Indicates the location of the displayed frame within the loop.
2 **Right review marker** – Indicates the ending of the loop.
3 **Left review marker** – Indicates the beginning of the loop.

Use the system presets or the Stress Echo screen to access the Maintenance dialog box and display the loop bar.

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Stress Echo
▶ Frame slider

To select a loop segment for display:

- Select the required segment from the drop-down list on the upper right of the screen.

To reposition a review marker for a single loop:

Note: The loop bar must be displayed for this procedure.

1. Select **User-defined** from the drop-down list on the upper right of the screen.

2. Select a loop.

3. Select a review marker on the loop bar for the selected loop.

    The trackball pointer changes shape to indicate that the review marker can be selected and to indicate that repositioning is available.

4. Roll the trackball to reposition the selected marker and then press the **ENTER** key to confirm the change.

Marker selection pointer.

To reposition the review markers for all loops:

1. Select **Fixed range** from the drop-down list on the upper right of the screen.

    The system displays a set of buttons (**–** and **+**) and a text box for each review marker at the top of the screen. The text box displays the frame number of the review marker.

Repositioning pointer.

2. To reposition the left review marker, select the left-most **–** or **+** button at the top of the screen.

    The system displays the new frame number of the left review marker.

3. To reposition the right review marker, select the right-most **–** or **+** button at the top of the screen.

    The system displays the new frame number of the right review marker.

Saving Stress Echo Data

Stress Echo data consists of Stress Echo loops, wall motion scores, LV volume measurements, and all other information pertaining to the Stress Echo portion of a patient examination. You can save all acquired loops (all loops acquired for each view) or you can save just the preferred loops (the single representative loop for each view).

To save all acquired loops:

- Select the **Save Examination** toolbar button.

  The system saves the Stress Echo data, including all acquired loops, to the storage device designated in system presets.

Save Examination
toolbar button.

To save the preferred loops only:

Note: You must select preferred loops for the continuous stages before using this save method.

- Select the **Save Examination (only selected loops)** toolbar button.

  The system saves the Stress Echo data, with only the selected "preferred" loops, to the storage device designated in system presets.

Save Examination
(only selected loops)
toolbar button.

Exiting the Stress Echo Feature

When you exit the Stress Echo feature, the system removes the display of the Stress Echo screen but the patient examination continues to be active.

To exit the Stress Echo feature:

Note: If later review of the Stress Echo data is required, then you must save the Stress Echo data before exiting the Stress Echo feature.

- Select the **Exit** toolbar button.

  The system removes the display of the Stress Echo screen.

Exit *toolbar button.*

Data Quantification and Reports

The Stress Echo feature has two types of reports: the **WMS-Report** and the **LV-Report**. The **WMS-Report** lists user-assigned wall motion scores and associated data while the **LV-Report** displays the user-created traces and associated calculations. Both reports contain the entered indication, if any; each report also contains any entered comments that are specific to the report. You can preview and print the report for the currently selected mode. You can also enable colored report printing.

Entering Indications or Comments for the Reports

You can enter an indication for display in both Stress Echo reports. You can enter a comment for inclusion in either report. You can enter predefined terms, which include factory default terms and user-defined terms.

To enter an indication:

1. Select the **Indication** toolbar button at the top of the screen.

2. If required, specify the reviewer either by using the keyboard to enter a name in the **Interpreter** text box or by selecting an existing name from the **Interpreter** drop-down list.

3. To enter a predefined term:

   a. Select the **Insert text** button on the right of the dialog box to display the **Select text to insert** dialog box.

   b. Select a predefined term from the list on the left of the dialog box.

   c. If required, change the settings (such as position and placement on a separate line) on the **Select text to insert** dialog box.

   d. Select the **OK** button to insert the selected term into the text box.

      The system closes the **Select text to insert** dialog box and redisplays the former dialog box.

4. Use the keyboard to enter text into the **Indication** dialog box and then select the **OK** button.

To enter a WMS comment for inclusion in the WMS-Report:

1. Select the **Enter WMS Comment** button on the lower right of the screen (when **Wall Motion Scoring Mode** is active) and then use the keyboard to enter text as required.

2. To enter a predefined term:

   a. Select the **Insert text** button on the right of the dialog box to display the **Select text to insert** dialog box.

   b. Select a predefined term from the list on the left of the dialog box.

   c. If required, change the settings (such as position and placement on a separate line) on the **Select text to insert** dialog box.

   d. Select the **OK** button to insert the selected term into the text box.

      The system closes the **Select text to insert** dialog box and redisplays the former dialog box.

3. Select the **OK** button on the upper right of the **WMS Comment** dialog box to save the entered text.

To enter an LV comment for inclusion in the LV-Report:

1. Select the **Enter LV Comment** button on the lower right of the screen (when **LV Mode** is active) and then use the keyboard to enter text as required.

2. To enter a predefined term:

   a. Select the **Insert text** button on the right of the dialog box to display the **Select text to insert** dialog box.

   b. Select a predefined term from the list on the left of the dialog box.

   c. If required, change the settings (such as position and placement on a separate line) on the **Select text to insert** dialog box.

   d. Select the **OK** button to insert the selected term into the text box.

      The system closes the **Select text to insert** dialog box and redisplays the former dialog box.

3. Select the **OK** button on the upper right of the **LV Function Comment** dialog box to save the entered text.

Modifying Lists of Predefined Terms

You can modify a list of predefined terms. The system maintains a list of predefined terms for each of the following items:

- Indications
- WMS (wall motion scoring) comments
- LV (left ventricle) comments

To modify a list of predefined terms:

1. Display the required list:
   - To display the list of predefined terms for indications, select the **Indication** toolbar button at the top of the screen and then select the **Insert text** button on the right of the **Indication** dialog box.
   - To display the list of predefined terms for WMS comments, select the **Enter WMS Comment** button on the lower right of the screen (when **Wall Motion Scoring Mode** is active) and then select the **Insert text** button on the right of the **Indication** dialog box.
   - To display the list of predefined terms for LV comments, select the **Enter LV Comment** button on the lower right of the screen (when **LV Mode** is active) and then select the **Insert text** button on the right of the **Indication** dialog box.

2. To edit a term:
   a. Select the predefined term and then select the **Edit** button at the bottom of the dialog box to display the **Edit text** dialog box.
   b. Use the keyboard to revise the term as required and then select the **OK** button to save changes and redisplay the **Select text to insert** dialog box.

3. To enter a new term:
   a. Select the **New** button at the bottom of the dialog box to display the **Create new text** dialog box.
   b. Use the keyboard to enter the new predefined term and then select the **OK** button to save changes and redisplay the **Select text to insert** dialog box.

4. To delete a term, select the term, select the **Delete** button at the bottom of the dialog box, and then confirm the deletion.

5. Select the **OK** button to close the **Select text to insert** dialog box and then select the **OK** button to close the formerly displayed dialog box.

Assigning Wall Motion Scores

You can assign wall motion scores to specific portions within each view (representative loop). You can also assign a normal WMS score to the currently selected view or to all displayed views.

To activate Wall Motion Scoring Mode from the Stress Echo screen:

▪ Select the **Wall Motion Scoring Mode** toolbar button at the top of the screen.

To assign a WMS score:

1. Activate **Wall Motion Scoring Mode**.

2. Select a colored number in the lower-right area of the screen.

3. Select a loop.

   The system outlines the loop in yellow to indicate selection.

4. Select the required portion of the WMS graphic that corresponds to the selected loop.

To assign a normal WMS score to all currently displayed loops:

▪ Select the **All Visible Loops Normal** button on the lower right of the screen.

To assign a normal WMS score to the currently selected loop:

▪ Select the **Selected Loop Normal** button on the lower right of the screen.

Measuring LV Volume

You can create a trace to measure the volume of the left ventricle (LV volume). You can adjust portions of the trace and you can adjust the center line. You can also undo a trace.

When you activate **LV Mode**, the system automatically displays the **2 Chamber** (**2Ch**) and **4 Chamber** (**4Ch**) views of the **Post** phase.

To activate LV Mode from the Stress Echo screen:

▪ Press the **CALIPER** key on the control panel or select the **LV Mode** toolbar button at the top of the screen.

To measure LV volume:

1. Activate **LV Mode**.

   The system displays the **Diastole** and **Systole** frames for the **2Ch** views of the **Rest** phase.

2. Select the required phase and view.

   The system displays the **Diastole** and **Systole** frames for the selected phase and view.

3. Roll the trackball to position the measurement marker on the required segment (for example, for the **2Ch** view, on the basal inferior segment) and then press the **SET** key.

   The system anchors the marker.

4. Roll the trackball to create a trace of the structure.

5. To anchor the marker as an end point for the current portion of the trace, press the **SET** key.

   The system anchors the marker as an end point for the current trace portion and as a beginning point for the next trace portion.

6. Repeat steps 4 through 5 for each portion of the trace.

7. To complete the trace, press the **SET** key twice in quick succession.

    The system changes the cursor to indicate a center line measurement.

8. Roll the trackball to measure the center line of the trace and then press the **SET** key.

    The system updates the values in the table at the bottom of the screen to display the current volume, diameter, and length for the selected frame (**Diastole** or **Systole**). The system shades the portion of the frame that represents the volume.

9. Repeat steps 1 through 8 for the second frame.

    The system updates the values in the table at the bottom of the screen to display the current volume, diameter, and length for the selected frame (**Diastole** or **Systole**). The system also updates other values in the table. The system shades the portion of the frame that represents the volume.

    Note: The system calculates biplane measurements when you measure LV volume for both 4 chamber and 2 chamber views and the length difference does not exceed 20 percent.

To adjust a portion of the trace:

1. Roll the trackball to the required portion of the trace.

   The system changes the color of the selected portion from green to yellow. The cursor changes to indicate selection of a trace portion.

2. Press the **SET** key to activate the trace portion.

3. Roll the trackball to adjust the trace portion and then press the **SET** key to complete the adjustment.

   The system updates the values in the table at the bottom of the screen to display the current volume, diameter, and length for the selected frame (**Diastole** or **Systole**). The system shades the portion of the image that represents the volume.

To adjust the center line measurement:

1. Roll the trackball to the line representing the center line.

   The cursor changes to indicate selection of the center line.

2. Press the **SET** key to activate the center line.

3. Roll the trackball to adjust the center line and then press the **SET** key to complete the adjustment.

   The system updates the values in the table at the bottom of the screen for the selected frame (**Diastole** or **Systole**). The system shades the portion of the image that represents the volume.

To undo the last created trace:

- Select the **Delete Contour** button on the right of the screen.

Delete Contour button.

Designating Phases for Inclusion in Reports

You can designate phase data for inclusion in or exclusion from a report.

The following information is always included in **LV-Reports** and **WMS-Reports**: patient name, ID, birthdate, sex, date of Stress Echo examination, and any user-entered indication or report-specific comment. In addition, **LV-Reports** include the patient's height, weight, and BSA; **WMS-Reports** include wall-motion scores for each segment, along with the sum and average for each phase.

Report Type	Phase Data Included When the Printer Graphic is Highlighted
LV-Report	▪ User-generated traces ▪ Measurement data ▪ Calculations
WMS-Report	▪ WMS graphics for each view, indicating each segment's wall-motion scores by color or degree of shading

To include data for a specific phase:

1. Activate the mode that pertains to the required report (**Wall Motion Scoring Mode** for **WMS-Report**; **LV Mode** for **LV-Report**).

2. Select (highlight) the printer graphic to the left of the phase.

3. To exclude the phase's data from the report, select the printer graphic again.

Previewing and Printing Reports

You can preview and print the report for the currently selected mode. You can also enable colored report printing. Report preview requires installation of a printer driver. Report printing requires system connection to a laser printer.

Note: Printer driver installation and laser printer connection must be completed by your Siemens service representative.

To preview the report for the currently selected mode:

Note: The **Report Preview** toolbar button is available only when a printer driver is installed.

■   Select the **Report Preview** toolbar button at the top of the screen.

To print the report for the currently selected mode:

Note: The **Print** toolbar button is available only when a laser printer is connected.

■   Select the **Print** toolbar button at the top of the screen.

To enable colored report printing (for WMS graphics):

1.   Select the **Maintenance** toolbar button at the top of the Stress Echo screen.

     The system displays the **Maintenance** dialog box.

2.   Select the **Print colored** check box in the **WMS Type** section of the dialog box.

Report Preview toolbar button.

Print toolbar button.

Maintenance toolbar button.

Loop Display and Other Stress Echo Options

You can configure options for the Stress Echo feature. Options determine system behavior during acquisition, appearance of loops in the Stress Echo screen, placement of WMS graphics relative to the loops they represent, type of line used for creating traces, lengths of systolic duration for specific heart rates, and available protocols.

System Reference

System Presets   Ch 3

▤
F4

Stress Echo

Accessing the Maintenance Dialog Box and the Protocol Editor Dialog Box

Stress Echo options are configured in the Stress Echo screen, the **Maintenance** dialog box, or the **Protocol Editor** dialog box. You can use the system presets or the Stress Echo screen to access the dialog boxes.

Note: Some options cannot be changed during **Acquire Mode**.

To access the Maintenance dialog box, choose one of the following methods:

- Select the **Maintenance** toolbar button at the top of the Stress Echo screen.

- Press the **F4** key on the keyboard to access the system presets and then select **Stress Echo** on the left of the system presets screen.

Maintenance
toolbar button.

To access the Protocol Editor dialog box:

1. Access the **Maintenance** dialog box.

2. Select the **Protocol Editor** button on the lower left of the **Maintenance** dialog box.

[2] Instructions for Use

Configuring
  Loop Display
  and Function   A8-30

Enabling Loop Overlays

When label display is enabled, the system overlays each loop with the identifying information as configured in the **Maintenance** dialog box.

To enable loop overlays:

1. Select (highlight) the **Labels on/off** toolbar button at the top of the screen.

   The system overlays the displayed loops with identifying information, such as the related phase and view.

2. To disable label display, select the **Labels on/off** toolbar button again.

Labels on/off toolbar button.

Configuring Loop Display and Compression

You can enable display of the reference image during acquisition (of phases after the initial phase), designate the level of image compression, and configure the overlays (labels) that display on loops in the Stress Echo screen (when label display is enabled). All settings are available in the **Maintenance** dialog box.

To access the Maintenance dialog box:

- Select the **Maintenance** toolbar button at the top of the Stress Echo screen.

To enable or disable display of the reference image during acquisition:

Note: The reference image is displayed if the initial stage was non-continuous.

- Select the required **Reference Image** option below and then select the **Save** button.
    - **On** enables display of the reference image
    - **Off** disables display of the reference image

To designate the level of image compression:

- Select the required **Image Compression** option and then select the **Save** button.

To configure the overlays (labels) that display on the loops:

- Select the check box for each **Overlay** option required for display and then select the **Save** button.

   When you enable loop overlays from the Stress Echo screen, the system includes each checked option in the displayed overlays.

Customizing the Display During Wall Motion Scoring Mode

The Stress Echo feature allows you to magnify the WMS (wall motion scoring) graphics and display them on the review section of the screen for closer viewing. You can configure the available WMS scores.

To toggle placement of views with placement of WMS graphics:

▪ Select the **Toggle Display** button on the lower right of the screen.

   The system displays the views (reduced in size) on the lower right of the screen and displays the corresponding WMS graphics (magnified) on the review section of the screen.

▪ To display the views and WMS graphics in their original locations, select the **Toggle Display** button again.

To configure the available WMS scores:

1. Select the **Maintenance** toolbar button at the top of the screen.

   The system displays the **Maintenance** dialog box.

2. Select the required **WMS Type** option and then select the **Save** button.

   The system removes the **Maintenance** dialog box from the screen.

Changing the LV Trace Line Method

You can change the type of LV trace line used in creating an LV trace.
The system allows you to use a solid line or a dotted line in the LV trace.

To change the LV trace line method:

1. Select the **Maintenance** toolbar button at the top of the screen.

   The system displays the **Maintenance** dialog box.

2. Select the required **LV Trace Line** option and then select the **Save** button.

   The system removes the **Maintenance** dialog box from the screen.

Customizing Systolic Duration Lengths as Related to Heart Rates

The **QT – Time Table** in the **Maintenance** dialog box allows you to customize the length of systolic duration acquired for a specific heart rate. You can add and remove entries in this table. You can also load the factory defaults.

To add an entry:

- Enter a heart rate and the referring systolic duration and then select the **Update** button.

To delete an entry:

- Select the required heart rate and systolic duration pair from the **QT - Time Table** and then select the **Delete** button.

To load the factory defaults:

- Select the **Factory Settings** button.

Changing the Stress Echo Protocols

You can create, edit, and delete Stress Echo protocols using the **Protocol Editor** dialog box. Your changes display in the **Select Protocol to load** window the next time you activate the Stress Echo feature.

Retrospective and Prospective (Continuous) Stages

When you create or edit a protocol, you can choose the number of phases, the number of loops acquired for each view in the phase, and included standard views. You can also name the protocol and its phases. (Phases are stages.)

You can designate the type of stage: continuous or non-continuous.

The loops in a given protocol are acquired by stages, according to stage configuration (continuous or non-continuous).

Loops in non-continuous stages are limited to a specified loop-per-view maximum (such as four). You must select a view label (such as **A4C**) before acquiring the loops. View labels can be selected only in the configured order. Acquisition is retrospective; when you press the **CALIPER** key, the system saves the previously acquired images.

Loops in continuous stages are limited by time rather than a maximum number of loops—the system stops acquisition after two minutes. Acquisition is prospective; when you select the stage label and then press the **CALIPER** key, the system starts saving newly acquired images. With this workflow, you assign view labels to the loops after acquisition is complete, using controls in the Stress Echo screen to select the "preferred" loop for each view.

The maximum allowed phases, views, and loops are listed below, along with default values and/or standard options.

Protocol Element	Maximum Allowed Per Protocol	Default Value	Standard Options
Phase	12	—	—
View	6	—	• PLAX • SAB • PSAX • SAA • A4C • A2C • ALAX
Loops (set by Phase) **Note:** This selection is not available for continuous stages.	20	4	—

To access the Protocol Editor dialog box from the Stress Echo screen:

1. Select the **Maintenance** toolbar button at the top of the Stress Echo screen.

   The system displays the **Maintenance** dialog box.

2. Select the **Protocol Editor** button on the lower left of the dialog box.

   The system displays the **Protocol Editor** dialog box.

To create a Stress Echo protocol:

1. Select the **New** button on the right of the **Protocol Editor** dialog box.

2. Enter the protocol name in the **Protocol Name** box at the top.

3. For each phase in the protocol:

   a. Select **<new>** from the **Phase** list.

   b. Enter a phase name in the **Description** box.

   c. Select the required option from the **continuous** drop-down list.

   d. Select the number of loops to acquire (per view in the selected phase) in the **Loops** list (for non-continuous stages).

4. For each view (all views display for each phase):

   a. Select **<new>** from the **View** list.

   b. Select a standard view from the **Standard View** list.

5. Select the **Save** button to save changes and then select the **Quit** button to remove the **Protocol Editor** dialog box from the screen.

To delete a protocol:

▪ Select the protocol or one of its component phases or views and then select the **Delete** button.

To edit a Stress Echo protocol:

Note: You cannot edit a protocol during **Acquire Mode**.

1. Select the **Load** button on the right.

   The system displays the **Select Protocol to load** window.

2. Select the protocol and then select **OK**.

   The system displays the name of the selected protocol in the **Protocol Name** box and lists the protocol's phases and views.

3. To change the name of the protocol, enter the required name in the **Protocol Name** box.

4. To change the name of a phase, select the phase and then enter the required name in the **Description** box.

5. To change the type of stage (continuous or non-continuous), select the appropriate option from the **continuous** drop-down list.

6. To change the number of loops acquired for each view in a phase, select the phase and then select the required number from the **Loops** list (for non-continuous stages).

7. To delete a phase or view, select the phase or view and then press the **Del** key on the keyboard.

8. Select the **Save** button to save changes and then select the **Quit** button to remove the **Protocol Editor** dialog box from the screen.

A9 SieScape Imaging

SieScape Imaging

⚠ **WARNING:** To avoid technique-related artifacts and measurement inaccuracies, read this entire chapter before using the SieScape feature.

The SieScape™ Panoramic Imaging feature is a system option that allows the acquisition of two-dimensional ultrasound images with a composite, extended field of view.

Image creation begins with a standard field of view, which extends during steady, forward motion scanning. You can confine the created image within a single scan plane (for example, a transverse scan of the abdomen) or not confine the image to a single plane (for example, when following the path of a tortuous vessel).

Intended Use

SieScape imaging is intended for the following uses:

- Imaging any structure where a field of view larger than standard real-time imaging is required; for example, large organs, masses, and long lengths of a vessel.
- Depicting anatomic relationships over a larger area than that provided by standard 2D-mode imaging.

Transducer Compatibility

Any system-supported curved array or linear array transducer is compatible with SieScape imaging.

- Linear (preferred)
- Curved (not intended for performing tightly curved SieScape scans)

Supported Study Types

All study types on the ultrasound system are compatible with SieScape imaging.

[1] Instructions for Use

SieScape Imaging ▪ Process Overview

SieScape imaging includes three processes:

- **Setup**. Allows you to set the scanning parameters for the image you intend to capture.
- **Acquire**. Builds the composite image as you move the transducer.
- **Review**. Presents the frozen composite image for your review.

Creating a SieScape Image

This section describes how to create a SieScape image, using the processes for **Setup** and **Acquire**.

To enter Setup:

▪ Press the **CRESCENDO** key.

> **Note:** If more than one advanced imaging option is installed on your system, for example, Siescape Imaging and StressEcho, press the **CRESCENDO** key and then select **OSieScape** on the LCD to activate the feature.

A ***bounding box*** displays on the 2D-mode image. This indicates the portion of the scanned image used to create the composite image.

The system activates one focal zone and sets the persistence 2D-mode parameter selection to zero. You can adjust the position of the focal zone marker, however, you cannot adjust the number of focal zones or persistence setting during SieScape imaging.
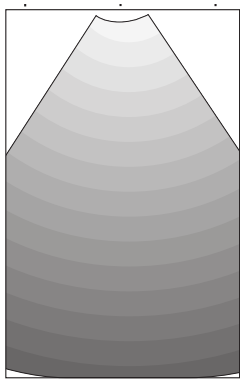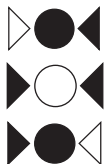
With curved array transducers, the bounding box is rectangular. With linear transducers, the bounding box should not exceed the lateral boundaries of the image. If necessary, decrease the image depth to increase the image size so the image fills the bounding box.

Image Acquisition

During the **Acquire** process, the system builds the composite image and indicates the status of your scan with a speed indicator and reference indicator.

Speed Indicator

The system displays the speed indicator during SieScape image acquisition. Optimal scanning speed is indicated when the circle is white. The two-stage shading of the indicator guides you toward optimal scanning speed.

Below optimum scan rate – increase scan speed slightly

Optimum scan rate

Above optimum scan rate, nearing "tear" speed – decrease scan speed slightly

The **Speed Indicator** *shows, by shading, the speed of scanning. To capture a SieScape image, use a steady speed.*

Scanning too slow can create unwanted compounding effects from patient breathing or erratic hand motion.

Scanning too fast can cause the image to **tear**, leaving small blank gaps in the image or jagged edges at the skin line and might cause the image to bend. Moving the transducer too fast can also distort the image geometry.

Reference Indicator

The reference indicator provides a "snapshot" of the entire SieScape image. Data displays in the reference indicator only during the SieScape **Acquire** process.

Example of a reference indicator.

To enter Acquire:

1. After entering SieScape **Setup**, press the **SET** key and then slowly and steadily scan in the desired direction.

    The system builds the composite image and indicates your scan speed with the speed indicator.
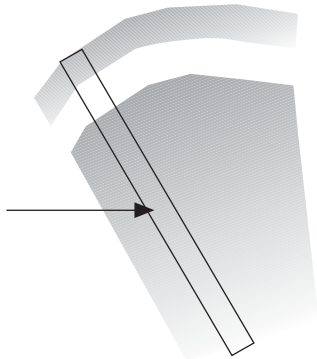
To help guide the alignment of the scan, the system displays a graphic **ROI** *to indicate the boundary between the composite image and the real-time image.*

2. To stop image acquisition, press the **FREEZE** key.

    Note: When the memory buffer for the SieScape image is full, the system automatically stops image acquisition and freezes the image.

    The system enters SieScape **Review**.

3. To reactivate **Acquire**, press the **FREEZE** key.

Reviewing a SieScape Image

Use SieScape **Review** after completing the **Setup** and **Acquire** process.

During **Review**, the system displays a flexible ruler along the length of acquisition and lateral margins of the acquired image in 1 cm increments with a larger marker every 5 cm.

Use the system presets to enable the default display of the flexible ruler.

SieScape LCD Selections

The system displays SieScape parameter selections during the SieScape Review process on the LCD. Use the SieScape selections to resize the acquired image.

You can also rotate and "pan" the image, depending on your image size.

Menu Selection	Description
Full	Scales the image to its full acquisition size.
Redisplay	Redisplay the SieScape image in the size and rotation selected prior to entering CINE (or previous size and rotation prior to reaccessing **OSetup**).
Restore	Scales the SieScape image to the original display of the frozen image.
Best Fit	Automatically scales the image to fit the image area.
Scale Display	Displays a flexible ruler along the length of acquisition.
Setup	Accesses the **Setup** screen.
Cine	Activates CINE review.

To Enter Review:

1. After activating SieScape **Setup** and **Acquire**, press the **FREEZE** key.

   The system freezes the image and automatically scales the image to **Best Fit**.

2. Use the following procedures to size, rotate or "pan" a SieScape image.

3. To unfreeze the image and reactivate SieScape **Setup**, press the **FREEZE** key.

   Note: During Review, you can also select **OSetup** on the SieScape LCD to access the setup screen.

   The system displays the **Image** task card with SieScape setup active as indicated by the bounding box on the image.

4. To activate standard 2D-mode imaging, press the **2D** control located on the control panel or select the **Image** task card tab.

Sizing an Image

Use the SieScape selections **Best Fit** and **Full** to resize the image.

- **Best Fit** automatically scales the image to fit the image area.
- **Full** scales the image to its full acquisition size.

You can also incrementally scale the image between **Best Fit** and **Full.** The resize increments are not fixed values but are evenly spaced values based on the Best Fit size at the time. The Best Fit size is dictated by the selected rotation.

During image sizing, the system displays a status indicator at the bottom of the image screen. The status indicator represents the range of scale from **Best Fit** to **Full** and the currently selected image size.

To size an image:

- To restore a scaled image to the original display of the frozen image, select **OFull** on the SieScape LCD.
- To scale the image to fit the image area, select **OBest Fit** on the SieScape LCD.
- To incrementally decrease or increase the scale of an image, rotate the **DEPTH/ZOOM** control on the control panel.

Rotating an Image

Rotation is possible on frozen SieScape images but not on SieScape images in CINE.

To rotate an image:

Note: If **Best Fit** is selected, rotating the image causes the system to automatically change the SieScape image's size to fit the image area.

- Rotate the **ANGLE** control on the control panel to turn the image in a clockwise or counterclockwise direction.

Panning an Image

Use the trackball to "move" or "pan" an image that is larger than the display area of the screen. You cannot "pan" an image when **Best Fit** is selected.

To pan an image:

- Roll the trackball to move the image in a left/right and up/down direction.

Reviewing CINE Images

A SieScape image is composed of hundreds of single frames. You can use the Cine function to recall single frames for review.

As with 2D-mode CINE, there is a finite CINE memory capacity. When a large SieScape image is acquired, the CINE frames may not be viewable from the beginning of the scan.

To review SieScape images during CINE:

1. During SieScape Review, select **OCine** on the SieScape LCD.

2. Roll the trackball left or right to display a "thumbnail" of the selected frame from the composite image on the right side of the image screen with a standard 2D-mode frame on the left side.

   The center of the reference box on the composite image indicates the position of the displayed single frame from the composite image.

3. Select **ORedisplay** on the SieScape LCD to redisplay the image in the size and rotation selected prior to entering CINE.

Measuring a SieScape Image

⚠ **WARNING:** To ensure accuracy, measurements should only be made on
SieScape images that are acquired in a single scan plane.

You can make general 2D-mode measurements on a frozen, full-sized or
best fit, composite image:

To ensure accurate results, measurements should not be made:

- On images that do not follow a single plane (for example, when tracking
a tortuous vessel). An out-of-plane image shows the contour pattern of
the skin line and the appearance of internal structures.

- Across a large shadow in a SieScape image

- Across gaps in an image, such as those encountered with a tightly
curved scan

- Across those areas of the image where the flexible ruler along the
skin line is jagged as this indicates that the image in this area has
disrupted, which causes inaccurate measurements

- On an image with a swirl at the bottom

Note: If the structure to be measured is contained within the boundary of a single,
standard 2D-mode frame, measurements should be made on the corresponding frame
retrieved from CINE and not on the SieScape image.

To activate the measurement function during SieScape imaging:

Note: The system presets option to automatically activate the measurement function
with the **FREEZE** key is not available during SieScape imaging.

- When a SieScape image is frozen, press the **CALIPER** key on the
control panel.

    The system activates the measurement function.

SieScape Imaging ▪ Technique Hints

This section includes information on how to obtain optimum SieScape images.

Adequate Gel

Apply a generous amount of coupling agent (gel) along the entire area to be scanned to avoid disrupting the scan sweep. Insufficient gel causes the transducer to drag on the skin.

Preview Sweep

Before acquiring a SieScape image, perform preview sweep of the scan plane in standard 2D-mode.

The maximum length of the composite image that can be acquired depends on the depth selected. That is, you can acquire approximately 8-10 times the selected depth for length (for example, for a linear SieScape scan).

Focus

To minimize possible bending artifacts, position the single focal zone in the optimum position as follows:

- Linear arrays – lower half of image
- Curved arrays – upper half of image

Gain

While in **Setup**, ensure the gain is balanced throughout the image. Low gain in the far field decreases the amount of data needed to ensure a geometrically correct SieScape image and can create a bending artifact.

When in **Acquire**, the image acquisition parameters cannot be changed (for example, number of focal zones, depth) with the exception of DGC, 2D-mode Gain, and Transmit Power. These controls can be used as with standard 2D-mode scanning to increase or decrease the gain in the image as you scan across structures of different densities.

Transducer

To avoid excessive bending and to ensure a constant elevation position, hold the transducer so that your little finger is in contact with the skin alongside the transducer face. This acts as a guide to ensure that the transducer is parallel to and in full contact (perpendicular) with the skin surface.

Plane

To ensure that you are staying in plane or correctly following a vessel, watch the trailing edge of the real-time portion of the image, which is located in the ROI. The remainder of the real-time image should be used as a guide to correct your rotation, as necessary, while scanning forward.

Scan Area

Scanning over a long length of superficial bone (for example, in the lower leg), which occupies the full width of a single frame, creates shadowing. Therefore, there is not enough data in the lower half of the image, which can cause excessive bending of the SieScape image.

Speed and Depth

Optimum scanning speed depends on depth. The Speed Indicator is related to the depth setting and indicates the optimum scanning speed for the specific exam type and transducer.

An optimum scan is indicated when the gray outline of the SieScape image in the Reference Indicator is solid gray. If this bar appears broken, you may have scanned too fast.

Note: To obtain the optimum SieScape images, scan slowly. If you move off plane or off the required path, you can stop your forward scan motion and correct your orientation in the real-time portion of the image before continuing.

[2] Instructions for Use

SieScape Imaging ▪ Avoiding Technique-Related Artifacts

⚠ **WARNING:** Technique-related artifacts unique to SieScape imaging can occur. Before using the SieScape imaging feature, be sure to read and understand the following information.

Plane Change Indications

A single plane image has a relatively smooth skin line contour. If the scan is "off plane," or off the required path, stop the forward scan motion and correct the scan orientation in the real-time image before continuing.

The following appearances in the image indicate a change in the plane:

- The skin line contour has the appearance of a "waving flag" and appears to have folds or shows a jagged broken skin line.
- Abrupt changes in boundaries (for example, boundaries that do not align) generally indicate that the plane has changed.

  Note: As you scan, ensure that anatomy and structures display as contiguous on the image screen.

- A structure, which is visible in the real-time portion of the image, abruptly disappears at the composite boundary.

Artificial Compounding

Use a forward scanning motion to avoid an unwanted image-compounding effect, which appears as a brighter, distorted section of the SieScape image.

Swirl Artifact

Optimum SieScape imaging occurs when the scanned surface is flat or gently curved. If a tightly curved scan is performed, a ***swirl*** compounding artifact occurs where the image overlaps in depth. Therefore, when performing a tightly curved scan (for example, transverse slice through the calf), set the depth as shallow as possible.

The depth should be less than the radius of the target area being scanned. This leaves a blank "hole" in the image. If the depth is too deep, the bottom of the image appears swirled. Never use an image with a swirl at the bottom for measurements.
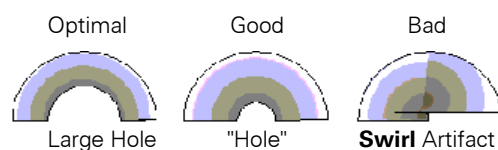
Example of curved SieScape images.

A10 *four*Sight 4D Imaging

*four*Sight 4D Imaging

(Option)

*four*Sight 4D imaging ultrasound technology acquires volumes and displays three-dimensional (3D) ultrasound images in real-time. The system applies Multi-Planar Reformatting (MPR) to the volume data set for a view of each plane (arbitrary slice).

Ultrasound data based on three-dimensional imaging methods can assist the diagnostic process. Volumes are suited for viewing and post processing (for example, arbitrary slicing, volume rendering, rotation and magnification of localized areas of interest).

Intended Use

The *four*Sight imaging feature can obtains views not available with standard 2D-mode ultrasound, such as the coronal view of an organ or oblique [arbitrary] slices of fetal anatomy. These views can help improve understanding of complex structures.

Three-dimensional imaging is intended for the following uses:

- Imaging of volumes to improve diagnostic analysis.
- Rotation of three-dimensional images (volume and MPRs) to view aspects of a structure that cannot be imaged directly.
- Examination of complex vascular structures and circulatory systems.

Compatibility

This feature is compatible with the following transducers:

- C6F3 *four*Sight 4D transducer

You can activate *four*Sight 4D imaging for any study type or exam type if the active transducer supports the feature.

Operating Modes

The *four*Sight imaging feature can be used with 2D-mode or 2D-mode with THI.

Process Overview

The following steps are involved in completing and reviewing a volume acquisition.

- **Setup:** Optimize the image and select settings for volume acquisition.

  Preparation for volume acquisition begins with scanning in 2D-mode. You can adjust the imaging parameters for the current transducer and exam type.

  After activating *four*Sight imaging, you can define a *four*Sight VOI (volume of interest) to limit acquisition to the data contained within the VOI. For example, you can limit acquisition to the fetal face.

- **Acquisition and View:** During acquisition, the system simultaneously processes the volume data and displays the current volume.

  The image of the acquired volume is continuously updated for speed settings 3, 4, and 5. For speed settings 1 and 2, the image of the volume is updated at the end of each transducer sweep.

  You can view MPRs (arbitrary slices) from volumes. The system simultaneously displays the orthogonal MPRs.

  You can change the VOI (volume of interest) or control the plane display to emphasize volume data for enhanced visualization.

- **Pause:** Pause volume acquisition to view the current volume.

- **Freeze:** Complete volume acquisition to review the volumes stored in the CINE buffer, define the displayed content, select display formats, change the surface appearance of the volume, rotate and pan the quadrants, remove volume data, save *four*Sight QuickSets, make measurements, and store volumes, clips, and images.

Acquiring Volumes

You can acquire up to 32 volumes in a session. When you activate *four*Sight 4D imaging, the system displays *four*Sight selections on the screen and in the **4D** tab as it begins acquiring volumes.

During acquisition, the system displays the acquisition rate in volumes per second (**v/s**) on the upper left of the screen.

To begin volume acquisition and change acquisition settings (when 4D is active):

1. If required, optimize the 2D-mode image using the 2D-mode imaging parameters.

2. Press the **3D/4D** key on the control panel to activate *four*Sight and begin volume acquisition.

3. To change acquisition settings, press the required LCD key on the 4D LCD.

To change this setting:	Press this LCD key:
Sweep angle	O**Scan Angle**
Rate for scanning	O**Scan Speed**
Display of the VOI (volume of interest)	O**VOI Control**
Shape for the VOI (volume of interest)	O**VOI Type**

4. To adjust the size or position of the VOI (volume of interest):

    a. To toggle the size and position functions, press the **SET** key on the control panel.

    b. Roll the trackball to resize or reposition the VOI.

    c. Press the **ESC** key on the control panel to deselect the VOI.

5. To cancel the acquisition, press the **2D** control on the control panel.

6. To complete volume acquisition, press the **FREEZE** key on the control panel.

To cancel acquisition and exit *four*Sight imaging:

▪ Press the **2D** control on the control panel.

Pausing Acquisition

You can pause volume acquisition to view the current volume.

To temporarily pause acquisition, choose a method:

▪ Press the O**Pause Motion** key on the 4D LCD.
▪ Select the **Pause Motion** icon on the left of the screen.

Pause Motion.

Completing Acquisition

You can complete (freeze) acquisition to review all volumes stored in the CINE buffer, change the display, and edit volume data.

To complete acquisition:

- Press the **FREEZE** key on the control panel.

  Note: When a volume is flipped, an R displays on the A and B quadrants.

Reviewing Acquired Volumes

You can review the volumes stored in the CINE buffer. You can also change the playback rate and the beginning and ending positions of the CINE data.

To review the volumes stored in the CINE buffer (when 4D is active):

1. If required, press the **FREEZE** key on the control panel to complete volume acquisition.

2. Choose a method to activate Volume Cine:

   Note: Use the system presets to automatically activate Volume Cine when you complete volume acquisition.

   – Press the **CINE** control on the control panel.

   – Press the **OVolume** key on the 4D LCD.

   – Press the **SET** key on the control panel to deselect the CINE data (if required) and then select the **Volume Cine** icon on the left of the screen.

3. To display the volume quadrant in full-screen format, press the **OImage Cine** key on the 4D LCD.

4. To cycle through the CINE data, roll the trackball.

F4

*four*Sight 4D
▶ 4D Preference
▶ ▶ CINE Control on
    Freeze

Volume Cine.

5. To start or stop playback of the CINE data, choose a method:

   – Press the **◐Motion Review** key on the 4D LCD.

   – Press the **SET** key on the control panel to deselect the CINE data (if required) and then select the **Cine (Image/ Volume) Motion Review** icon on the left of the screen.

6. To change the playback rate (during review of CINE data), press the **◐Rate** key on the 4D LCD to cycle through the settings.

Cine (Image/ Volume) Motion Review.

Repositioning CINE Markers

You can change the beginning or ending position for review of CINE data.

The system displays a 4D CINE bar at the bottom of the screen when acquisition is completed. The 4D CINE bar indicates the CINE memory buffer and contains the following elements:

Example of 4D CINE bar.

1 **Volume Counter** – Indicates the number of the displayed volume.

2 **Left CINE marker** – Indicates the beginning of the CINE data. This marker can be repositioned to edit the length of the CINE data.

3 **Right CINE marker** – Indicates the end of the CINE data. This marker can be repositioned to edit the length of the CINE data.

4 **Volume Indicator** – Indicates the location of the volume within the CINE data.

To change the beginning or ending position (during review of CINE data):

1. Roll the trackball to display the required volume.

2. Press the **◐Edit Start** key or the **◐Edit End** key on the 4D LCD.

3. To restore the original positions, press the **◐Reset Edit** key on the 4D LCD.

Viewing Volumes and MPRs

Quadrants are referred to as A, B, C, and 3D. Quadrant 3D contains the volume data set and the other quadrants contain MPRs of the displayed volume. MPRs are Multi-Planar Reformatting (MPR) quadrants, also known as planes or arbitrary slices. The MPRs are initially oriented at the center of the volume; each MPR is orthogonal to the other two MPRs.

Quadrant Name	Location in 4:1 Display Format	Color of Outline
A – acquisition plane	Upper right	Blue
B – transverse plane	Upper left	Yellow
C – coronal plane	Lower left	Red
3D – volume	Lower right	Green

You can define the displayed content, select display formats, change the volume's surface appearance, rotate and pan quadrants, remove volume data, restore default settings, magnify quadrants, and display the wireframe, intersection lines, and trackball assignment symbols.

The system displays the acquisition rate in volumes per second (**v/s**) on the upper left of the screen.

Use the system presets to specify the initial display format for the volumes and MPRs during and after volume acquisition.

Displaying Toolbars and Subtoolbars

You can display the volume and MPR toolbars. You can also display subtoolbars (containing additional icons) for specific functions (toolbar icons).

To:	Do this:
Display the volume toolbar	▪ Roll the trackball to position the cursor on the volume quadrant.
Display the MPR toolbar	▪ Roll the trackball to position the cursor on an MPR quadrant.
Select a toolbar icon (on the toolbar or subtoolbar)	▪ Roll the trackball to position the cursor on the toolbar icon and then press the **SET** key on the control panel.
Display the subtoolbar (containing additional icons) for a toolbar icon	▪ Roll the trackball to position the cursor on the toolbar icon and then press the **UPDATE** key on the control panel.

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F4

*four*Sight 4D
▶ Mode Transition Setting
▶ ▶ Initial Mode for High-Speed Motion
▶ ▶ Initial Mode for Low-Speed Motion

VOI Control.

Defining the Displayed Content (VOI)

You can enable the VOI (volume of interest) to define the displayed content of the acquired volume data in the volume quadrant. You can also change the shape, size, and position of the VOI. When the VOI is enabled, the MPRs (Quadrants A, B, and C) do not shift position according to the volume position.

The system displays the VOI on Quadrants A and B (upper quadrants in the **4:1** display format). The volume data within the VOI is displayed in the volume quadrant (lower right quadrant in the **4:1** display format).
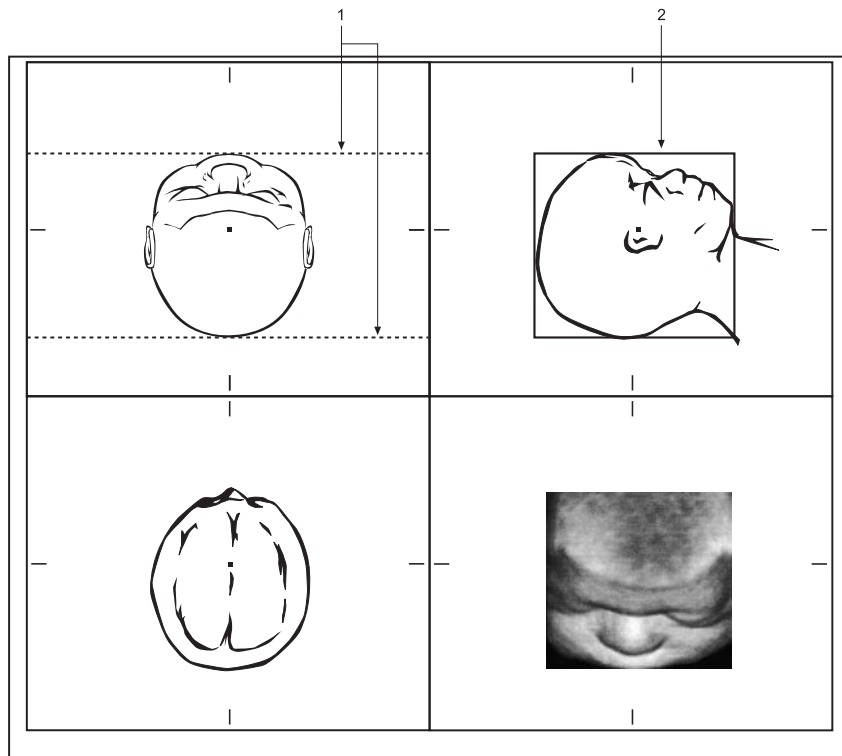
1   VOI as displayed on Quadrant B (transverse plane)

2   VOI as displayed on Quadrant A (acquisition plane)

*Example of the VOI (**4:1** display format).*

To enable the VOI (when 4D is active), choose a method:

- Press the **OVOI Control** key on the 4D LCD.
- Select the **VOI Control** icon on the left of the screen.

VOI Control.

Changing the Shape, Size, and Position of the VOI

To change the shape of the VOI (when 4D is active):

▪ Press the **OVOI Type** key on the 4D LCD.

To change the size or position of the displayed VOI (when 4D is active):

1. To select the VOI, roll the trackball to Quadrant A (upper left quadrant) and then press the **SET** key on the control panel.

    The system assigns unique colors to the top line and to the other lines to indicate selection of the VOI.

2. To toggle the size and position functions, press the **SET** key.

3. Roll the trackball to resize or reposition the VOI.

4. Press the **ESC** key on the control panel to deselect the VOI.

Selecting a Display Format

You can select a display format for the volume and MPR quadrants.

Use the system presets to configure keys on the control panel for selected display format functions.

To change the display format (when 4D is active), choose a method:

▪ Press the **OLayout >>** key on the 4D LCD to display the available Layout LCD selections and then press the key for the required display format.

▪ Select the required display format icon on the left of the screen.

4:1 (V).	*4:1 (H).*	*4:1.*	*3D Only.*
A	**B**	**C**	
A Only.	*B Only.*	*C Only.*	*A + 3D.*

▪ Press a key on the control panel that is configured for the required display format function.

F4

*four*Sight 4D
► 4D Preference
► ► 3D/4D Key Function
► ► Double Click

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[1] Instructions for Use

Selections for
  *four*Sight 4D
  Imaging   Ch 3

Changing the Surface Appearance of the Volume Data Set

You can render and post-process the volume data set to change its surface appearance.

Rendering Volumes

You can select a rendering method to change the surface appearance of the volume data set.

Note: Use the system presets to customize toolbars.

To select a rendering method (when 4D is active), choose a method:

- Press the **OMethod** key on the 4D LCD to cycle through selections.

- Select the required rendering method icon:

    a. Roll the trackball to position the cursor on the rendering method icon in the volume toolbar and then press the **UPDATE** key on the control panel to display additional icons.

    b. Select the required icon.

Surface.	*Max.*	*Min.*	*Mean.*
Surface 1.	*Surface 2.*	*Surface 3.*	*Surface 4.*

F4

*four*Sight 4D
► Toolbar Setting
► ► MPR
► ► 3D

[1] Instructions for Use

Selections for
  *four*Sight
  4D Imaging   Ch 3

Post-Processing the Data

You can change the surface appearance of the volume data set and the MPRs by adjusting post-processing parameters, such as noise cut or penetration.

Note: Use the system presets to customize toolbars.

To adjust post-processing parameters (when 4D is active):

- Press the required key on the 4D LCD.

- Select the required icon on the left of the screen.

- Select the required icon from the volume toolbar or the MPR toolbar.

Selecting and Customizing Image Color Schemes

You can select and customize image color schemes.

Use the system presets to restore the default list of color schemes and restore the color scheme from the selected *four*Sight QuickSet.

To select a color scheme for the image (when 4D is active):

- Press the **⭕Palette >>** key on the 4D LCD to display the Palette LCD selections and then press the key for the required color scheme.

- Select the **Palette** icon on the left of the screen to display the Palette dialog box, select the required color scheme, and then select **OK**.

To customize a color scheme (when 4D is active):

1. Choose a method to display the Palette dialog box:

   – Press the **⭕Palette >>** key on the 4D LCD to display the Palette LCD selections and then press the **⭕Palette Window** key.

   – Select the **Palette** icon on the left of the screen.

2. To display another page of color schemes, select a page number from the **Page** selection at the top of the dialog box.

3. Select the color scheme and then select **Edit** to display the **Edit Palette** dialog box.

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F4

*four*Sight 4D
▶ Default
▶▶ Toolbar Position
▶ Toolbar Setting
▶▶ MPR
▶▶ 3D

[1] Instructions for Use

Selections
  for *four*Sight
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*four*Sight 4D
▶ Default
▶▶ Palette

🎨

Palette.

🎨

Palette.

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4. If required, change the type of color scheme:

    –   To include a color range (highlight, mid-range, and shadows) in the color scheme, select **Multi** in the **Adjust Color** section of the dialog box.

    –   To include only the mid-range color in the color scheme, select **Single** in the **Adjust Color** section of the dialog box.

5. To change a color in the color scheme:

    a. Select the button for the color. For example, to change the mid-range color, select the **Mid-range** button.

        The system displays the Color Definition dialog box.

    b. Select a color button in the **Basic colors** list or the **Custom colors** list on the left of the dialog box to display the color's settings on the right of the dialog box.

    c. To change a color value, roll the trackball to position the cursor in the required text box and then use the keyboard to edit the value. For example, roll the trackball to position the cursor in the **Sat** text box to change the saturation value.

    d. Select **OK** to save changes and redisplay the **Edit Palette** dialog box.

6. To save the current settings as a new color scheme, roll the trackball to position the cursor in the **Name** text box and then use the keyboard to enter a name.

7. Select **Save** to save changes and redisplay the Palette dialog box.

8. To reposition the selected color scheme within the dialog box, select the color scheme and then select **Up** or **Down**.

9. Select **Save** to save changes and exit the Palette dialog box.

Rotating and Panning Quadrants

You can rotate and pan (shift) the volume and MPRs. Rotation can help you visualize anatomic structures.

Note: MPRs do not change orientation or position when the VOI is enabled.

The system displays the reverse symbol "R" on the upper right of MPR quadrants that have a reversed orientation in relation to the volume quadrant.

Note: Use the system presets to customize toolbars.

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*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

To rotate the volume and MPRs clockwise in 90-degree increments (when 4D is active):

▪   Press the **ROTATE** key on the control panel.

To rotate the volume and MPRs (when 4D is active):

1. To display or hide the rotation axis graphics on the quadrants, choose a method:

    –   Press the **◯Cross Mark** key on the 4D LCD.

    –   Select the **Cross Mark** icon on the left of the screen.

Cross Mark.

2. Press the **M** control on the control panel to select the required rotation axis (indicated by the trackball assignment symbols).

Trackball assignment symbol for X axis rotation.   *Trackball assignment symbol for Y axis rotation.*   *Trackball assignment symbol for Z axis rotation.*

3. Rotate the **M** control on the control panel.

To pan the volume and MPRs (when 4D is active):

1. Select the **Move Volume** icon from the volume toolbar and then roll the trackball.

2. To exit the panning function, select the **Move Volume** icon again.

Move Volume.

To rotate or pan the selected quadrant using the trackball (when 4D is active):

1. Roll the trackball to a quadrant and then press the **SET** key on the control panel.

    The system changes the cursor color to indicate trackball arbitration.

2. To cycle through the available functions, repeatedly press the **UPDATE** key on the control panel.

    The system changes the cursor shape to indicate the active function.

X and Y Axes Rotation cursor.   *Z Axis Rotation cursor.*   *Panning Rotation cursor.*

3. To select another axis for rotation of the volume, select the related icon from the MPR toolbar.

    –   **Rotate around horizontal axis (U/D):** X axis of rotation.

    –   **Rotate around vertical axis (L/R):** Y axis of rotation.

4. Roll the trackball to rotate the volume and MPRs around the selected axis of rotation (or to pan the volume and MPRs).

5. To exit the active function, press the **SET** key again.

Rotate around horizontal axis (U/D).

Rotate around vertical axis (L/R).

Automatically Rotating Volumes

You can automatically rotate the currently displayed volume. You can also change automatic rotation settings.

Use the system presets to specify initial settings for automatic rotation.

To change automatic rotation settings (when 4D is active), choose a method:

▪ Press the **〇Auto View >>** key on the 4D LCD to display the Auto View LCD keys and then press the required LCD key:

To change this setting:	Press this LCD key:
View angle	**〇View Angle**
Angle step	**〇Angle Step**
Direction	**〇Direction**

▪ To change the direction, select the related icon on the left of the screen.

Auto View H.   *Auto View H/L.*   *Auto View V.*   *Auto View V/L.*

To start or stop automatic rotation of the currently displayed volume, choose a method (when 4D is active):

▪ Press the **〇Auto View >>** key on the 4D LCD to display the Auto View LCD selections and then press the **〇Auto View** key.

▪ Select the **Auto View** icon on the left of the screen.

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*four*Sight 4D
► Mode Transition
   Setting
►► Initial Mode for High-
   Speed Motion
►► Initial Mode for Low-
   Speed Motion

Auto View.

Removing Data from Volumes

Note: You must disable the VOI to remove volume data.

You can remove data to clarify anatomical structures.

Rotating the volume may help you to determine the type of edit required.

Controlling the Plane Display

You can control the plane display in the volume data set by defining a cut plane on either the acquisition quadrant or the volume quadrant. You can also traverse active MPRs through volumes along the orthogonal axis. Traversing the MPR is also called ***stepping through the volume***.

When you control the plane display, the system removes data in front of the cut plane. This data removal can indicate the location of the anatomy of interest in relation to the volume data set. Rotation can help you visualize anatomic structure.

Note: Use the system presets to customize toolbars.

To define the cut plane on the acquisition quadrant (when 4D is active):

Note: You must disable the VOI to control the plane display in the volume data set.

1. Choose a method to activate the front cut plane:
   – Press the **OFront Cut** key on the 4D LCD.
   – Select the **Front Cut** icon from the volume toolbar.

   The system displays the front cut plane on the acquisition quadrant and removes volume data in the volume quadrant that is in front of the front cut plane. The system also changes the shape of the cursor to indicate that the front cut plane is selected.

2. Roll the trackball to adjust the position of the front cut plane and then press the **SET** key on the control panel to confirm the current position.

3. To retain the current position of the front cut plane on the volume regardless of rotation, roll the trackball to position the cursor on the **Scalpel** icon on the volume or MPR toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Scalpel By Clip** icon.

   The system removes image data above the front cut plane on the MPRs.

4. To deactivate the front cut plane, choose a method:
   – Press the **OFront Cut** key on the 4D LCD.
   – Select the **Front Cut** icon from the volume toolbar.

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*four*Sight 4D
▶Toolbar Setting
▶▶MPR
▶▶3D

Front Cut.

Front Cut cursor.

Scalpel.

Scalpel By Clip.

To define the cut plane on the volume quadrant (when 4D is active):

Note: You must disable the VOI to control the plane display in the volume data set.

1. Rotate the volume to position the area requiring editing so that it faces you.

2. Roll the trackball to position the cursor on the **Front Cut** icon or the **Bubble Clip** icon on the volume or MPR toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select one of the following icons:

   – **Box Clip**: Removes data by the selected planes.

   – **Niche Clip**: Removes data by the selected planes, in the selected size.

   The system displays a three-dimensional box around the volume data. If you selected the niche clip function, then the system also displays a cube on the front corner of the volume.

3. To control a plane:

   a. Press the **UPDATE** key on the control panel to cycle through the planes.

   b. Roll the trackball to control the currently selected plane.

   Note: If you selected the niche clip function, then you can control the size of the removed data in addition to the position of the selected plane.

4. Press the **SET** key on the control panel to complete the edit and exit the editing function.

To step through the volume (when 4D is active):

Note: To remove data while you are stepping through the volume, define a cut plane.

1. Roll the trackball to position the cursor on the **Move Volume** icon in the volume toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Back and Forth Move** icon.

2. Roll the trackball to step through the volume data set.

3. To exit the function, press the **SET** key on the control panel.

Box Clip.

Niche Clip.

Move Volume.

Back and Forth Move.

Drawing Freeform Shapes for Data Removal

You can draw a freeform shape around the area of volume data to be excluded or included.

To draw a freeform shape for data removal (when 4D is active):

Note: You must disable the VOI to edit the volume.

1. Select the **Scalpel** icon from the volume or MPR toolbar to activate the editing cursor.

   The system changes the cursor shape to indicate the active editing function.

2. Roll the trackball to position the cursor on the volume or MPR at the beginning point of the freeform drawing and then press the **SET** key on the control panel.

3. Roll the trackball to draw a shape around the area to be removed (or retained) and then press the **SET** key.

   Note: If the drawn line does not complete a circle, the system automatically closes the circle with a straight line, from the first endpoint to the last endpoint, when you press the **SET** key.

   The system changes the cursor shape to a deletion cursor. The area of the volume (inside or outside the drawn circle) at the position of the cursor is colored red.

4. To delete the part of the volume inside the drawn circle, position the deletion cursor inside the circle and then press the **SET** key to complete the edit and exit the editing function.

5. To delete the part of the volume outside the drawn circle, position the deletion cursor outside the circle and then press the **SET** key to complete the edit and exit the editing function.

6. To cancel removal of the volume data, press the **ESC** key on the control panel.

Scalpel.

Scalpel cursor.

Deletion cursor.

Selecting Elliptical Areas for Removal

You can select an elliptical area of volume data for removal.

Note: Use the system presets to customize toolbars.

To select an ellipses-shaped area for removal (when 4D is active):

Note: You must disable the VOI to edit the volume.

1. Roll the trackball to position the cursor on the **Scalpel** icon on the volume or MPR toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Scalpel Ellipse** icon to activate the editing cursor.

   The system changes the cursor shape to indicate the active editing function.

2. Roll the trackball to position the cursor on the area of the volume or MPR to be removed and then press the **SET** key on the control panel to preview the data selected for removal.

3. If required, roll the trackball to reposition the cursor.

4. To complete the edit and exit the editing function, press the **SET** key again.

5. To cancel removal of the volume data, press the **ESC** key on the control panel.

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*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

Scalpel Ellipse.

Scalpel Ellipse cursor.

Limiting Data Using Elliptical Boundaries

You can limit the displayed data using defined elliptical boundaries.

Note: Use the system presets to customize toolbars.

To define elliptical boundaries for limiting the volume data (when 4D is active):

Note: You must disable the VOI to edit the volume.

1. Select the **Bubble Clip** icon on the volume or MPR toolbar to display the default elliptical boundaries on the MPRs.

   Note: You can also select the **Bubble Clip** icon by displaying the subtoolbar for the **Front Cut** icon on the toolbar. Roll the trackball to position the cursor on the **Front Cut** icon on the toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Bubble Clip** icon to activate the editing cursor.

   The system removes all volume data outside the elliptical boundaries.

2. To resize the elliptical boundaries:

   a. Roll the trackball to position the cursor on the left, right, top, or bottom point of a boundary and then press the **SET** key on the control panel.

      The system changes the cursor shape to indicate that the selected boundary point is selected for repositioning.

   b. Roll the trackball to reposition the selected boundary point and then press the **SET** key again.

   c. To cancel resizing of the boundaries, press the **ESC** key on the control panel.

3. To remove the elliptical boundaries from the MPRs and redisplay all volume data, select the **Bubble Clip** icon on the volume or MPR toolbar again.

F4

*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

Bubble Clip.

Bubble Clip repositioning cursor.

Canceling Edits

You can cancel (remove) completed Scalpel and Scalpel Ellipse edits. You can also restore recently removed Scalpel and Scalpel Ellipse edits.

Note: Use the system presets to customize toolbars.

To remove the most recent Scalpel or Scalpel Ellipse edit, choose a method (when 4D is active):

▪ Press the **⊙Undo** key on the 4D LCD.

▪ Select the **Undo** icon on the left of the screen.

To restore the most recently removed Scalpel or Scalpel Ellipse edit (when 4D is active):

▪ Select the **Redo** icon on the left of the screen.

To remove all Scalpel and Scalpel Ellipse edits, choose a method (when 4D is active):

▪ Roll the trackball to position the cursor on the **Reset All** icon on the MPR toolbar or volume toolbar, press the **UPDATE** key on the control panel to display additional toolbar icons, and then select the **Remove Edits** icon.

▪ Select the **Remove Edits** icon on the left of the screen.

▪ Press the **⊙Remove Edits** key on the 4D LCD.

Restoring Selected Data

You can select and restore previously removed volume data.

Restoring Data with Freeform Shapes

You can draw a freeform shape around the area of volume data to be restored.

Note: Use the system presets to customize toolbars.

F4

*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

Undo.

Redo.

Reset All.

Remove Edits.

F4

*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

To draw a freeform shape for restoring removed data (when 4D is active):

Note: You must disable the VOI to edit the volume.

1. Roll the trackball to position the cursor on the **Scalpel** icon on the MPR toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Undo Scalpel** icon to activate the editing cursor.

    The system changes the cursor shape to indicate the active editing function.

2. Roll the trackball to position the cursor on the volume or MPR at the beginning point of the freeform drawing and then press the **SET** key on the control panel.

3. Roll the trackball to draw a shape around the area to be restored and then press the **SET** key.

    Note: If the drawn line does not complete a circle, the system automatically closes the circle with a straight line, from the first endpoint to the last endpoint, when you press the **SET** key.

    The system changes the cursor shape to a deletion cursor. The area of the volume (inside or outside the drawn circle) at the position of the cursor is colored blue.

4. To restore the part of the volume inside the drawn circle, position the cursor inside the circle and then press the **SET** key to complete the edit and exit the editing function.

5. To restore the part of the volume outside the drawn circle, position the cursor outside the circle and then press the **SET** key to complete the edit and exit the editing function.

6. To cancel restoration of the data, press the **ESC** key on the control panel.

Undo Scalpel.

Undo Scalpel cursor.

Deletion cursor.

Restoring Data with Elliptical Shapes

You can restore an elliptically shaped area of volume data.

Note: Use the system presets to customize toolbars.

To restore an elliptically shaped area of data (when 4D is active):

Note: You must disable the VOI to edit the volume.

1. Roll the trackball to position the cursor on the **Scalpel** icon on the volume or MPR toolbar, press the **UPDATE** key on the control panel to display additional icons, and then select the **Undo Scalpel Ellipse** icon to activate the editing cursor.

    The system changes the cursor shape to indicate the active editing function.

2. To complete the edit and exit the editing function, roll the trackball to position the cursor on the area of the volume or MPR to be restored and then press the **SET** key.

3. To cancel restoration of the data, press the **ESC** key on the control panel.

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*four*Sight 4D
▶ Toolbar Setting
▶ ▶ MPR
▶ ▶ 3D

Undo Scalpel Ellipse.

Undo Scalpel Ellipse cursor.

Restoring Default Settings

You can restore the default settings for orientation, position, size, and other QuickSet parameters from the selected *four*Sight QuickSet and remove all edits. You can also restore selected default settings.

Note: Use the system presets to customize toolbars.

To restore all default settings (when 4D is active):

▪ Press the **OReset All** key on the 4D LCD.

▪ Select the **Reset All** icon on the MPR toolbar or volume toolbar.

▪ Select the **Reset All** icon on the left of the screen.

To restore selected default settings (when 4D is active):

▪ Select the required icon from the left of the screen or from the volume or MPR toolbar.

Note: To display the following icons on the volume or MPR toolbar, roll the trackball to position the cursor on the **Reset All** icon on the toolbar and then press the **UPDATE** key on the control panel.

To restore this setting:	Select this icon:
Position of volume and MPRs	*Reset Position.*
Orientation of volume and MPRs	*Reset Orientation.*
Size of volume and MPRs	*Reset Zoom.*
Brightness and contrast for volume and MPRs	*Reset Brightness/Contrast.*
Noise cut and penetration for volume and MPRs	*Reset Noise Cut/Penetration.*

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*four*Sight 4D
▶Toolbar Setting
▶▶MPR
▶▶3D

Reset All.

Magnifying Quadrants

You can magnify the currently displayed volume or the MPR quadrants.

Note: Use the system presets to customize toolbars.

To magnify the currently displayed volume (when 4D is active), choose a method:

- Roll the trackball to position the cursor on the **Move Volume** icon on the volume toolbar, press the **UPDATE** key on the control panel to display additional toolbar icons, and then select the **Zoom** icon.

- Press the **DEPTH/ZOOM** key on the control panel to select the volume (if required) and then rotate the **DEPTH/ZOOM** key.

  Note: The selected quadrant (volume or MPR quadrants) is indicated by a trackball assignment symbol on the upper left of the quadrant when the **Cross Mark** function is enabled. To enable the **Cross Mark** function, press the **◯Wireframe** key on the 4D LCD or select the **Cross Mark** icon on the left of the screen.

To magnify the MPRs (when 4D is active), choose a method:

- Select the **Zoom** icon from the MPR toolbar.

- Press the **DEPTH/ZOOM** key on the control panel to select the MPR quadrants (if required), and then rotate the **DEPTH/ZOOM** key.

  Note: The selected quadrant (volume or MPR quadrants) is indicated by a trackball assignment symbol on the upper left of the quadrant when the **Cross Mark** function is enabled. To enable the **Cross Mark** function, press the **◯Wireframe** key on the 4D LCD or select the **Cross Mark** icon on the left of the screen.

F4

*four*Sight 4D
▶ Toolbar Setting
▶▶ MPR
▶▶ 3D

Move Volume.

Zoom.

Cross Mark.

Trackball assignment symbol for magnification.

Displaying the Wireframe, Intersection Lines, and Trackball Assignment Symbols

You can enable or disable the display of the wireframe graphic (gray outline indicating boundaries) on the volume data set. You can also enable or disable display of the intersection lines and trackball assignment symbols on all quadrants. Trackball assignment symbols indicate the quadrants assigned to the trackball for magnification and/or rotation.

To toggle display of the wireframe on or off (when 4D is active), choose a method:

- Press the **OWireframe** key on the 4D LCD.
- Select the **Wireframe** icon on the left of the screen.

To toggle display of the intersection lines and trackball assignment symbols on or off (when 4D is active), choose a method:

- Press the **OCross Mark** key on the 4D LCD.
- Select the **Cross Mark** icon on the left of the screen.

Wireframe.

Cross Mark.

Saving, Retrieving, and Deleting *four*Sight QuickSets

You can save, retrieve, and delete *four*Sight QuickSets containing settings for acquisition and display of volumes.

*four*Sight QuickSets contain the following settings:

- **Scan Speed**
- **Scan Angle**
- **3D Brightness**
- **3D Contrast**
- **MPR Brightn.**
- **MPR Contrast**

- **Method**
- **Front Cut**
- **Noise Cut**
- **Penetration**
- **Auto Tuning**
- **Detail**

- **Smooth Filter**
- **Cross Mark**
- **Wireframe**
- Currently selected Palette setting
- Front cut plane position
- VOI type, position, size, and angle

To save a *four*Sight QuickSet:

1. During 4D imaging, adjust settings as required.

2. Choose a method to display the *four*Sight QuickSet dialog box:

    –   Press the **OLoad Q.S >>** key on the 4D LCD to display the QuickSet LCD selections and then press the **O4D QS Screen** key to display the *four*Sight QuickSet dialog box.

    –   Select the **QuickSet** icon on the left of the screen.

    QuickSet.

3. Roll the trackball to position the cursor in the **Name** text box, press the **SET** key on the control panel, and then use the keyboard to enter a name.

4. Select **New** to save the *four*Sight QuickSet.

5. To activate the new *four*Sight QuickSet, select **Enable**.

6. Select **Exit** to exit the dialog box.

To retrieve a *four*Sight QuickSet (when 4D is active), choose a method:

▪ Press the **◯Load Q.S >>** key on the 4D LCD to display the QuickSet LCD selections and then press the key for the required *four*Sight QuickSet.

QuickSet.

▪ Select the *four*Sight QuickSet from the *four*Sight QuickSet dialog box:

    a. Select the **QuickSet** icon on the left of the screen to display the *four*Sight QuickSet dialog box.

    b. Select the required *four*Sight QuickSet and then select **Enable** to activate the *four*Sight QuickSet.

    c. Select **Exit** to exit the dialog box.

To delete a *four*Sight QuickSet (when 4D is active):

1. Choose a method to display the *four*Sight QuickSet dialog box:

    – Press the **◯Load Q.S >>** key on the 4D LCD to display the QuickSet LCD selections and then press the **◯4D QS Screen** key to display the *four*Sight QuickSet dialog box.

QuickSet.

    – Select the **QuickSet** icon on the left of the screen.

2. Select the required *four*Sight QuickSet and then select **Delete**.

Making Measurements

Note: Siemens recommends not measuring across MPR quadrants. Perform each measurement in an individual MPR quadrant.

You can use general 2D-mode measurements and calculations on MPR quadrants during *four*Sight 4D imaging. The active measurement method displays on the left side of the image screen. The Measured Results display on the bottom of the image screen. Measured results are not transferred to the patient report.

Note: If the measured results overlay the quadrant used for measurements, then rotate the **SELECT-R** LCD control to reposition the measured results.

The following measurements are not available during 4D imaging:

Note: Measurements are not available for volumes acquired with the **Scan Speed** setting of 5.

- Angle
- Volume: 1PI Ellipse, 2 PI Trace, Thyroid

Storing, Printing, and Retrieving

You can store volumes and clips, store and print images of volumes, and retrieve volumes from previous examinations.

Use the system presets to hide or display the toolbar when storing and printing images.

Storing Volumes

You can store a volume or a sequence of volumes to the system's hard disk. A sequence of volumes consists of all *four*Sight volumes in the CINE buffer.

To store the currently displayed volume, choose a method (when 4D is active):

▪ Press the **⭕Save >>** key on the 4D LCD and then press the **⭕Save Volume** key.

▪ Select the **Save Volume** icon on the left of the screen.

To store the sequence of *four*Sight volumes stored to the CINE buffer (when 4D is active), choose a method:

▪ Press the **⭕Save >>** key on the 4D LCD and then press the **⭕Save Volume Cine** key.

▪ Select the **Save Volume Cine** icon on the left of the screen.

Save Volume.

Storing Clips

You can store clips of the currently displayed volume(s) during continuous review of acquired volumes or during automatic rotation.

To store a clip of the volumes in the CINE buffer (when 4D is active):

▪ Select the **Save Image Cine** icon on the left of the screen.

▪ Press the **⭕Image Cine** key on the 4D LCD to enable Image Cine and then press the **⭕Save Clip** key on the 4D LCD.

To store a clip of the current volume using the automatic rotation settings (when 4D is active):

1. If the automatic rotation is currently playing, then stop playback by selecting the **Auto View** icon on the left of the screen.

   Note: Alternatively, press the **⭕Auto View >>** key on the 4D LCD to display the Auto View LCD selections and then press the **⭕Auto View** key.

2. Choose a method to store a clip:

   – Press the **⭕Save Auto View** key on the 4D LCD.

   – Select the **Save Image Cine** icon on the left of the screen.

Save Volume Cine.

Save Image Cine.

Auto View.

Storing and Printing Images

You can store and print images of volumes to the system's hard disk.

Use the system presets to assign each key to print and/or store function(s).

Note: The system does not automatically store the volumes when you print or store images. If you plan to retrieve one or more of the volumes after the examination ends, store the volumes.

To store an image (when 4D is active), choose a method:

- Press the documentation control that is configured in the system presets for the storage function.

- Select the **Save Image** icon on the left of the screen.

- Press the **⬤Save >>** key on the 4D LCD and then press the **⬤Save Image** key on the 4D LCD.

To print an image (when 4D is active):

- Press the documentation control that is configured in the system presets for the required printer.

Retrieving Volumes

You can retrieve volumes and volume sequences from the current examination or from a previous examination.

The representative image saved with the volume or sequence is displayed in the DIMAQ-IP Image screen for the study selected in the Study screen. The representative image retains applied colors and other settings that were active at the time the volume dataset was stored; however, the retrieved volume dataset does not retain these settings.

To retrieve a volume or volume sequence for the current study:

1. Press the **REVIEW** key on the control panel.

   The system displays the image(s), including any clips, for the current examination in the DIMAQ-IP Image screen. Each image associated with a volume dataset has a 4D icon on the right.

2. Select the 4D icon on the image associated with the volume dataset.

   The system displays the volume dataset along with *four*Sight 4D imaging selections.

F4

Customize Keys

Save Image.

4D icon.

To retrieve a volume or volume sequence from a completed study that is saved to the system's hard disk:

Note: If the study is stored on external disk media (such as a CD), then you must import the study to the hard drive to retrieve the volume dataset.

1. Press the **REVIEW** key on the control panel.

2. If the system displays the DIMAQ-IP Image screen, then select the **Study Screen** button to display the Study screen.

3. Select **HD** in the **Disk** section of the Study screen.

4. Double-click the study, or select the study and then select the **Image Screen** button. Alternatively, you can press the **UPDATE** key to toggle the Study screen with the Image screen.

    Note: When you use the **UPDATE** key, the system does not display the Image screen unless the study selected on the Study screen contains images.

    The system displays the image(s), including any clips, in the Image screen. Each image associated with a volume dataset has a 4D icon on the upper left.

5. Select the 4D icon on the image associated with the volume dataset.

    The system displays the volume dataset along with *four*Sight 4D imaging selections.

4D icon.

System Presets for *four*Sight 4D Imaging

You can view and change the system presets for 4D imaging.

Preset Main Menu: *four*Sight 4D

To display the ***four*Sight 4D Preset Main Menu** screen, press the **F4** key on the keyboard to display the **Preset Main Menu** and then select the ***four*Sight 4D** menu item on the left of the screen.

Selection	Option(s)	Description(s)
Mode Transition Setting	---	Displays a screen for configuring initial 4D display options.
4D Preference	---	Displays a screen for assigning selected 4D functions to controls on the control panel.
Toolbar Setting	---	(Heading [title] for a group of menu items.)
MPR	---	Displays a screen for customizing the MPR toolbar.
3D	---	Displays a screen for customizing the volume toolbar.
Hide Toolbar When Saving or Printing	**ON, OFF**	Excludes the toolbar from printed and stored images.
Default	---	(Heading [title] for a group of menu items.)
Toolbar Position	---	Restores the default position for each quadrant's toolbar.
Palette	---	Restores the default list of color schemes and restores the color scheme from the selected *four*Sight QuickSet.
Dynamic Range - Initial value	**OFF, 45, 50, 55, 60, 65**	Specifies the initial value for dynamic range.
Auto View: Step	**1, 2, 4, 10, 20, 30, 45**	Specifies the initial setting for the angle step used during automatic rotation. This setting is displayed on the LCD for Auto View (**◯Angle Step**).
Auto View: Angle	**10, 20, 30, 45, 60, 90, 180**	Specifies the initial setting for the view angle used during automatic rotation. This setting is displayed on the LCD for Auto View (**◯View Angle**).
Auto View: Direction	**Down, Loop-down-up, Right, Loop-right-left**	Specifies the initial setting for the direction used during automatic rotation. This setting is displayed on the LCD for Auto View (**◯Direction**). **Down = V** **Loop-down-up = V/L** **Right = H** **Loop-right-left = H/L**

Mode Transition Setting Screen Selections

To display the **Mode Transition Setting** screen, select the **Mode Transition Setting** button on the ***four*Sight 4D Preset Main Menu** screen.

These options affect the layout, rotation, and other display options every time you activate 4D.

Selection	Option(s)	Description(s)
Initial Mode for High-Speed Motion	---	(Heading [title] for a group of menu items.)
VOI Control	on, off	Enables the VOI (volume of interest) during volume acquisition when the acquisition rate is one volume per second or faster.
MPR + 3D	on, off	Disables the VOI (volume of interest) during volume acquisition when the acquisition rate is one volume per second or faster.
Initial Mode for Low-Speed Motion	---	(Heading [title] for a group of menu items.)
VOI Control	on, off	Enables the VOI (volume of interest) during volume acquisition when the acquisition rate is slower than one volume per second.
No Motion	on, off	Enables the VOI (volume of interest) during volume acquisition when the acquisition rate is slower than one volume per second. Disables real-time update of the acquired volume.
Exam	(lists all exam types)	Specifies the exam type for configuration of layout and rotation options.
Layout	---	(Heading [title] for a group of menu items.)
Initial Layout at Starting of 4D Mode		Specifies the initial display format when 4D imaging is activated.

Selection	Option(s)	Description(s)
Layout at Freeze (From 2- / 4-Up)	---	(Heading [title] for a group of menu items.)
Select Layout		Specifies the initial display format when volume acquisition is completed.
Keep Layout	on, off	Retains the current display format when volume acquisition is completed.
Rotate	---	(Heading [title] for a group of menu items.)
Rotate	**0, 90, 180, 270**	Rotates the volume the selected number of degrees in the clockwise direction.

4D Preference Screen Selections

To display the **4D Preference** screen, select the **4D Preference** button on the *four*Sight **4D Preset Main Menu** screen.

Selection	Option(s)	Description(s)
3D/4D Key Function	**OFF, Volume 1up, Cursor 1up**	Assigns the selected function to the **3D/4D** key on the control panel when 4D imaging is active. ▪ **Volume 1up:** Toggles full-screen display format of the volume with the most recently selected display format. ▪ **Cursor 1up:** Toggles full-screen display format of the selected quadrant with the most recently selected display format.
Double Click	**OFF, ON**	Toggles full-screen display format of the selected quadrant with the most recently selected display format. when you press the **SET** key twice in quick succession.
CINE Control on Freeze	**ON, OFF**	Automatically activates Volume Cine when you press **FREEZE** to complete volume acquisition.

ToolBar Arrangement Screen Selections

The **ToolBar Arrangement** screen is available in the following versions:

- **MPR Toolbar menu setting**

- **3D Toolbar menu setting**

To display the **ToolBar Arrangement** screen (**MPR Toolbar menu setting**), select the **MPR** button in the **Toolbar Setting** section of the *four*Sight 4D **Preset Main Menu** screen.

To display the **ToolBar Arrangement** screen (**3D Toolbar menu setting**), select the **3D** button in the **Toolbar Setting** section of the *four*Sight 4D **Preset Main Menu** screen.

This screen displays the current toolbar and the available toolbar icons (excluding subtoolbar icons), along with buttons for inserting, removing, or repositioning toolbar icons.

Note: Each toolbar can accommodate a maximum of six toolbar icons.

Icon	Selection	Description
▲	**Add**	Adds the selected toolbar icon (in the **Select Item** section of the screen) to the toolbar (at the top of the screen). The selected icon is inserted to the left of the most recently selected icon in the toolbar.
		Note: If the toolbar already contains the maximum number of icons, then the system automatically removes the right-most toolbar icon.
▼	**Remove**	Removes the selected toolbar icon from the toolbar at the top of the screen. Toolbar icons not on the toolbar are displayed in the **Select Item** section of the screen.
◄	**Left**	Repositions the selected toolbar icon in the toolbar at the top of the screen one icon to the left.
►	**Right**	Repositions the selected toolbar icon in the toolbar at the top of the screen one icon to the right.

B1 Measurements and Calculations

Measurement Function ▪ Overview

The measurement function contains the measurements and calculations available for each exam type and imaging mode. You can use the measurement function during a patient examination, on images stored in CINE Review, or on images stored on a VCR using the VISS indexing protocol. You can also make measurements on images stored to disk, except those saved as TIFF images.

When the measurement function is active:

- The LCD lists measurement methods for the active exam type and imaging mode.

- The trackball controls the placement of measurement markers (calipers) and selection of measurement labels.

- The Measurement Menu displays selectable labels along the left side of the image screen. When available, a report uses these labels to identify measurement values.

- The Measured Results display results of the measurements and calculations at the bottom of the image screen. Measured Results placement is user-selectable.

General and Exam-Specific Measurements

The ultrasound system contains measurements and calculations that are either *General* – standard for all exam types – or *Exam-specific* – particular to one exam type.

Calculations use formulas that require specific measurements. The system automatically performs a calculation when the required measurements have been completed.

System Presets

Access the system presets by pressing the **F4** key on the keyboard. Using the system presets, you can specify system setup parameters. You can also configure each exam type to display user-defined measurements and customized LCD measurement selections. The system presets also provide choices, depending on exam type, for user-defined labels, formulas, and comments.

Activating the Measurement Function

Activate the measurement function by pressing the **CALIPER** key. When you press the **CALIPER** key, the LCD displays measurement selections appropriate for the imaging mode and exam type. The system also places the first marker in a *caliper* set (set of measurement markers) in the image area. To access a Measurement Menu directly, press the **CALIPER** key a second time.

Use the system presets to automatically activate the measurement function each time you press the **FREEZE** key. If this default has not been set, press the **CALIPER** key to enter the measurement function while an image is frozen for M-mode and Doppler. You can perform measurements on a real-time or frozen 2D-mode image.

Use the system presets to assign the position of the trackball pointer (caliper) when you activate the measurement function. The system will do one of the following:

- Place the first measurement marker in the center of the image screen.

- Highlight the Measurement Menu.

- Display the first measurement marker with a dotted line, representing the depth from the skin line and indicating the Depth in the Measured Results.

The active exam type and Measurement Menu display on the left side of the image screen. The Measured Results display on the bottom of the image screen.

Caliper

System Reference

System Presets   Ch 3

F4

Default Settings
▶ Automatic **FREEZE**
  Response
M&R
▶ Caliper Default
  Position

Measurement Calipers

After you press the **CALIPER** key to activate the measurement function, the trackball is active in either the image screen or the Measurement Menu. Select the trackball active location in the system presets. If the trackball is active in the image, the system places the first measurement marker of a *caliper set* on the image screen. If the trackball is active in the Measurement Menu, you can press the **CALIPER** key again to switch trackball control to the image screen and display the first measurement marker.

Each caliper set includes one or more pairs of measurement markers for indicating the beginning and ending points of a measurement. Some caliper sets require multiple measurements to calculate one value; all related markers are identified with the same caliper set number. The system can display a maximum of eight caliper sets at one time. If you attempt to add more caliper sets, the system prompts you to press the **ESC** key and then press the **CALIPER** key to enable eight more caliper sets. All labeled measurements are retained.

Maximum On-Screen Calipers

Depending on the measurement, up to eight caliper sets can display on an image at one time. Use the system presets to select the shape and size of a caliper measurement marker.

System Reference

System Presets   Ch 3

F4

M&R
▶ Caliper Default
   Position
▶ Shape Pattern
▶ Shape Size

Caliper Type	Description	Mode
+ + x x	Indicate beginning and ending points for each pair of markers.	**2D-mode:** Depth, Distance, Area, Circumference, and Volume
		M-mode: Distance, Slope, Velocity, Diameter Flow Volume
⎢ ⎢	Delineates beginning and ending positions for marking horizontal position or an interval.	**M-mode:** Time, Heart Rate
		Doppler: Time, Heart Rate, Pulsatility Index, Point Values (single), Average Values, Flow Volume
┼	Indicates both a vertical and a horizontal position.	**Doppler:** Velocity, Frequency, Resistive Index, Acceleration - Deceleration, and Slope

Caliper Sets and Measurement Data

A number displays next to the first marker of each marker pair. This number identifies the caliper set and the corresponding measurement data that displays in the Measured Results. The number may be repeated if multiple measurements are required in the same image.

Positioning and Anchoring Calipers

Position a measurement marker by rolling the trackball. An active marker is green. Anchor a marker by pressing the **SET** key. An anchored marker is white. A second measurement marker in a caliper set displays near the first marker. Position the second marker by rolling the trackball; the system automatically updates the value of the measurement in the Measured Results. Anchor the second marker by pressing the **SET** key.

Measurement Menu

Activating the measurement function causes the system to display a Measurement Menu on the left side of the image screen. The Measurement Menu indicates the selected measurement method and contains system and any user-defined labels for the active exam type and imaging mode.

If the menu has additional pages (e.g., during OB measurements), access the pages by rolling the trackball to the page number at the bottom of the menu and then pressing the **SET** key. With the cursor active in the Measurement Menu, you can also rotate the **SELECT** control on the control panel to cycle through multiple pages.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement and then assign the measured value to a label **–** *Measure then Label* **–** or select a label and then use the default measurement method for the selected label to perform the measurement **–** *Label then Measure*.

Some measurements require the use of specific measurement methods. When you highlight a label in the Measurement Menu, the system automatically displays the required measurement method at the top of the menu.

When a label has been assigned a measured result, the system displays the value next to the label in the Measured Results section of the screen. To view the labeled values in an exam with a patient report, press the **F2** key on the keyboard at any time during the exam or select **Report** in the Measurement Menu during the measurement function.

The following exams contain specific labels that are assignable to a value for display in a report: OB, Early OB, GYN, C-Vas, P-Vas, Venous, Ortho, EM, Cardiac, and Urology.

To measure then label:

Note: Use the system presets to customize the system to display a measurement marker in the image when you activate the measurement function.

1. During an exam, acquire and freeze the image, sweep, or spectrum.

2. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays any measurement labels available for this exam type.

3. Select a measurement method from the LCD. Select the method required by the measurement label.

    The system places a measurement marker in the image. The system displays measurement data in the Measured Results, such as (**D**) for distance, (**C**) for circumference, and (**A**) for area. The system also displays the corresponding measurement units, such as **mm** for distance and circumference, and **cm²** for area.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system automatically updates the measurement data in the Measured Results.

6. To assign the measurement data to a label, roll the trackball to select the measurement label in the Measurement Menu and then press the **SET** key.

    The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

7. If the selected label requires additional measurement data, the system activates a new measurement marker in the image area. Continue making measurements until all items called for in the Measured Results have been completed. The system then assigns the Measured Results to the measurement label in the Measurement Menu.

    Note: Raw and labeled measurement data displays while a measurement is in progress. Raw (unlabeled) measurement data will not be retained when you exit the measurement function. Labeled measurement data reappears when the measurement function is reentered.

To label then measure:

Note: Use the system presets to assign the trackball to the Measurement Menu when you activate the measurement function.

Note: If the trackball is not assigned to the Measurement Menu after activating the measurement function, press the **CALIPER** key to place the trackball pointer in the Measurement Menu. The system activates the default measurement method for the active exam type and imaging mode.

1. During an exam, acquire and freeze the image, sweep, or spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays any measurement labels available for this exam.

3. Roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system displays the measurement method required for the selected label at the top of the Measurement Menu, activates that measurement method, and places a measurement marker in the image. The system also displays measurement data in the Measured Results.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key to complete the measurement. Measurement data updates in the Measured Results as each measurement is made.

6. To continue measurements, repeat steps 3 – 5 as required.

   When all required measurements are complete, the system displays the measurement label and corresponding value in the Measured Results and assigns the value to the label in the worksheet and the patient report.

Label Undo

You can undo the most-recent label assignment. If you have begun another measurement or changed modes, you cannot undo a label assignment.

To undo a label assignment:

- Roll the trackball to highlight the most recently assigned label in the Measurement Menu and then press **⊘Undo** on the measurement LCD.

   The system deselects the label and removes the associated Measured Results.

Default Measurement Methods by Imaging Mode

Imaging Mode	Default measurement
2D-mode	Distance (2D-mode measurement)
2D/M-mode	Distance (M-mode measurement)
2D-mode with Doppler	Velocity (Doppler measurement)
2D/M-mode /Doppler	Velocity (Doppler measurement)
Doppler	Velocity

Measured Results

Values from measurements and calculations display in the Measured Results on the bottom of the image screen. Measured Results display as raw measurement data until all steps required by the selected measurement method have been completed. If available in the Measurement Menu, a label can then be assigned; the completed Measured Results are labeled accordingly. If a label is not available or if a measurement method is used that is not compatible with any label, the completed Measured Results are not labeled and retain the display format used when they were still raw measurement data.

All raw measurement data and unlabeled Measured Results are deleted when the measurement function is deactivated. Completed, labeled Measured Results are retained; you can access them again by pressing the **CALIPER** key to reactivate the measurement function.

Note: When the measurement function is active, you can rotate the **SELECT-R** control on the LCD panel to reposition the Measured Results area on the screen. You can also press the **SELECT-R** control to hide the Measured Results. Pressing the control a second time redisplays the Measured Results.

General Measurements ▪ Abbreviations of Measured Results

2D-mode Measurement	Unit	Abbreviation
Distance, diameter, trace, circumference	millimeters	mm
Area	centimeters^2	cm^2
Angle	degrees	º
Volume, one or two-plane	cubic centimeters	cm^3
Volume, residual urine, prostate	milliliter	mL
Flow volume, area or diameter*	liters per minute	L/min
%Stenosis	percent	%

Also requires Doppler measurement

M-mode Measurement	Unit	Abbreviation
Distance	millimeters	mm
Heart rate	beats per minute	bpm
Time	milliseconds	ms
Slope	millimeters per second	mm/s
Velocity	meters per second	m/s
Flow volume, area or diameter*	liters per minute	L/min

Also requires 2D-mode measurements

Doppler Measurement	Unit	Abbreviation
Velocity or frequency	centimeters per second or kilohertz	cm/s or kHz
Heart rate	beats per minute	bpm
Time	milliseconds	ms
Accel	meters per second squared	m/s^2
Systole, peak	centimeters per second or kilohertz	cm/s or kHz
Diastole, minimum	centimeters per second or kilohertz	cm/s or kHz
Time average velocity	centimeters per second or kilohertz	cm/s or kHz
Flow volume, diameter*	liters per minute	L/min
Pressure, mean or peak	millimeters mercury	mmHg

Also requires 2D-mode measurements

Editing Measured Results

You can edit Measured Results that have been completed during the current session of the measurement function. If you cancel and then reactivate the measurement function, previously completed Measured Results display again, but cannot be edited.

To activate Measured Results editing of measurement data:

1. Press the **SELECT** control on the control panel after completing all the required measurement data and prior to exiting the measurement function.

   Measurement data displays in the Measured Results, with the most recently acquired data highlighted.

2. Rotate the **SELECT** control to select other data for editing.

3. To begin editing the highlighted data, press either the **SET** key on the control panel or the **OModify** selection on the LCD.

   The system activates the most recently used marker for the selected measurement data.

4. Roll the trackball to reposition this marker and then press the **SET** key to anchor the new marker position.

   The system activates the next most recently used marker for the selected measurement data.

5. Continue pressing the **SET** key, adjusting markers with the trackball, and selecting new measurement data with the **SELECT** control.

6. To exit Measured Results editing, press the **SELECT** control.

You can edit Measured Results values in a Worksheet. Worksheets are available with the OB, Early OB, and Cardiac exams. Some exam types that have reports but no worksheets allow for editing in their reports. Examples are: C-Vas, P-Vas, and Venous.

Deleting Measurements

You can remove measurements from the screen. The values of the removed measurements remain in the Measured Results and in the patient report.

To remove the last measurement from the screen:

1. Press the **SELECT** control on the control panel after completing all the required measurement data and prior to exiting the measurement function.

   Measurement data displays in the Measured Results, with the most recently acquired data highlighted.

2. Rotate the **SELECT** control to select other data for editing.

3. To delete the measurement, press the **◯Delete** selection on the LCD.

4. To exit Measured Results editing, press the **SELECT** control.

To remove all measurements from the screen:

1. Press the **SELECT** control on the control panel after completing all the required measurement data and prior to exiting the measurement function.

   Measurement data displays in the Measured Results, with the most recently acquired data highlighted.

2. To delete all measurements, press the **◯Delete All** selection on the LCD.

3. To exit Measured Results editing, press the **SELECT** control.

Exiting the Measurement Function

Raw measurement data, completed Measured Results, and the Measurement Menu are erased from the image screen when you exit the measurement function by unfreezing the image or by pressing the **ESC** key on the control panel. The system discards raw measurement data but retains all Measurement Label assignments and completed Measured Results for the exam. The system discards Measurement Label assignments and completed Measured Results if a new patient is selected or if the power is cycled.

General Measurements

The system can calculate a ratio of measured values in all exam types and imaging modes.

Calculating a Ratio of Measured Results

Use the ⭗**A/BRatio** LCD selection to determine ratios for the following measurements:

Mode	Measurement	Ratio
2D-mode	Distance, area, or volume	A/B B/A (A - B)/A
M-mode	Distance, heart rate, or time	A/B B/A (A - B)/A
Doppler	Velocity or frequency	A/B B/A (A - B)/A

To determine a ratio:

1. Activate the measurement function.

    The system displays a measurement marker.

2. If you are using a measurement other than the default, select the measurement method on the LCD.

    You can select any distance, area, or volume measurement in 2D-mode; any distance, heart rate, or time measurement in M-mode; or any velocity or frequency measurement in Doppler.

3. Press ⭗**A/B Ratio** on the LCD.

4. Complete the first measurement.

5. Perform the second measurement. You must use the same method selected for the first measurement.

    When you complete the second measurement, the measurement ratio is also completed. If a ratio label is available, you can now assign the label to the measured value. The Measured Results display the measurements for A, B, A/B, B/A, and (A-B)/A, and any labeled measured values.

General 2D-Mode Measurements and Calculations

General 2D-mode measurements include depth, distance, and circumference and calculations for area, volume, and ratios. The system displays measurement data for General Measurements. If you use a General Measurement method required by a label, you can assign the measurement to that label.

General Caliper Performance in 2D-Mode

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key on the control panel.
Make another measurement	Press the **CALIPER** key on the control panel after the measurement is complete.
Exit the measurement function	Press the **ESC** key or the **FREEZE** key on the control panel to unfreeze the image.

Measuring Depth

If selected as an option in the system presets, depth is automatically measured when the first measurement marker displays on the image. The distance from a point on the transducer–skin interface to the marker is displayed in the Measured Results until the first marker is anchored.

Measuring Straight-Line Distance

Distance is the default measurement method for 2D-mode and displays as the measurement method when the **CALIPER** key is pressed. The distance measurement calculates the length of a straight line between two markers.

To make a distance measurement:

1. Activate the measurement function.

2. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the first marker and displays a second marker.

3. Roll the trackball to position the second measurement marker.

   The system automatically updates the distance (**D**) in the Measured Results.

4. To complete the measurement, press the **SET** key.

   The measured distance (**D**) displays in the Measured Results.

Measuring Trace Distance

Measure distance for non-straight lines by using the **OTrace Length** 2D-mode measurement LCD selection.

To make a trace distance measurement:

1. Activate the measurement function.

2. Press **OTrace Length** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

4. Roll the trackball to trace a distance with a second measurement marker.

   The system automatically updates the distance (**D**) in the Measured Results.

5. To untrace, rotate the **SELECT** control on the control panel counterclockwise. Rotate the **SELECT** control clockwise to retrieve deleted portions of the trace.

6. To complete the measurement, press the **SET** key.

   The measured distance (**D**) displays in the Measured Results.

System Reference

System Presets   Ch 3

📋

F4

M&R
▶ Caliper Default
   Position

Making the Ellipse Measurement

The Ellipse measurement method is used to determine the circumference and area by positioning a graphical ellipse over the structure of interest.

Ellipse Circumference Measurement Accuracy

The formula used for computing the circumference is most accurate when the two diameters used in the measurement, D_1 and D_2, are close to being equal.

Note: Common formulas for the calculation of the Ellipse circumference are approximations. The formula used by the system will provide an accurate result (< 2% error) as long as one diameter does not become more than twice the other.

If a circumference measurement is required for image areas where the ratio of the diameters is more than 2-to-1, the Trace method is recommended to ensure adequate measurement accuracy.

To make an ellipse measurement:

1. Activate the measurement function.

2. Press **◯Area**, then press **◯Ellipse** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

    The system anchors the marker, displays an ellipse, and displays two diameters (**D1**, **D2**), the circumference (**C**), and the area (**A**) in the Measured Results.

4. Roll the trackball to rotate the first axis and adjust the size of the ellipse and then press the **SET** key.

    The system updates the measurement data in the Measured Results.

5. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

    The system updates the measurement data in the Measured Results.

6. Roll the trackball to position the ellipse on the image and then press the **SET** key to anchor the ellipse.

Making a Trace Circumference Measurement

The Trace method is used to manually determine the circumference of a structure. The system calculates the area inside the trace.

To perform a trace measurement:

1. Activate the measurement function.

2. Press **OArea**, then press **OTrace** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to create a trace of the structure.

   Note: You can rotate the **SELECT** control on the control panel to delete the trace before completing the circumference. Rotate **SELECT** counter clockwise to delete the trace or clockwise to redraw deleted portions of the trace.

5. To complete the trace, press the **SET** key.

   The system displays the circumference (**C**) and area (**A**) of the traced structure in the Measured Results.

Making a Cross Circumference Measurement

The Cross method allows you to measure the circumference and area of a structure defined by two diameters.

To perform a cross measurement:

1. Activate the measurement function.

2. Press **OArea**, and then press **OCross** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

    The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

    The system anchors the second marker and displays a circle. The two diameters (**D1**, **D2**), circumference (**C**), and area (**A**) values display in the Measured Results.

5. Roll the trackball to adjust the length and position of the second axis and then press the **SET** key.

    The system updates the diameter (**D1**, **D2**), circumference (**C**), and area (**A**) values.

6. Roll the trackball to skew one side of the structure while the other side is held stationary.

7. Press the **SET** key to complete the Cross pattern and measurements.

Making a Spline Circumference Measurement

The Spline method allows you to measure the circumference and area of a structure established with three or more marker positions.

To perform a spline measurement:

1. Activate the measurement function.

2. Press **⭘Area**, then press **⭘Spline** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the second marker and displays a third marker. A circle connects the three markers, and the circumference (**C**) and area (**A**) display in the Measured Results.

5. Roll the trackball to position the third measurement marker, adjusting the shape of the structure, and then press the **SET** key.

   The system anchors the third marker and displays a fourth marker connected to the structure. The circumference and area values update in the Measured Results.

6. Continue setting marker points as necessary to further define the structure.

7. To complete the measurement, press the **SET** key twice at the same point to end the last marker placement.

Measuring an Angle

The Angle measurement requires the placement of two lines to determine an angle. The lines must intersect or connect. The system calculates and displays both angles formed by the two lines. The Angle measurement is not available with all exam types.

To measure an angle:

1. Activate the measurement function.

2. Press **OAngle** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker at the beginning of the reference line and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker at the end of the reference line and then press the **SET** key.

   The system anchors the reference line and displays a third measurement marker.

5. Roll the trackball to position the third measurement marker at the beginning of the angle line and then press the **SET** key.

   The system anchors the marker and displays a fourth marker.

6. Roll the trackball to position the fourth measurement marker at the end of the angle line and then press the **SET** key.

   The system anchors the angle line, labels the α angle and β angle, and displays the angle values in the Measured Results.

Making a Two-Plane Volume Calculation

The two-plane volume calculation requires measurements to be performed in two separate planes, using two 2D images. The system requires measurements in two planes for the following volume calculations:

- **2PI LxDxW**
- **2PI Ellipse**
- **2PI Trace**
- **Thyroid**

Note: Except for the thyroid volume, the procedures for each volume calculation describe the steps for making measurements in Dual-mode. To use full-screen 2D-mode images, follow the instructions in the note at the beginning of each procedure.

LxDxW Method

LxDxW is the default method for two-plane volume calculations. To use this method, obtain three distance measurements: length and depth in one plane, and width in another plane. The system uses the following formula to calculate the volume:

$$Volume = \frac{(\pi \times L \times D \times W)}{6}.$$

The system assumes you will perform the measurements in the sequence length, depth, and width. If you are using two single 2D-mode images, you must perform two measurements in the first plane.

To obtain a two-plane volume using the LxDxW method:

Note: The procedure below assumes you have acquired images in Dual-mode. If single 2D-mode images are used, perform the first six steps below on one image. Unfreeze the system. If you press the **ESC** key on the control panel, the system erases the measurements. Acquire and freeze the second image. Press the **CALIPER** key on the control panel, and then perform steps 7 and 8. The system displays the saved values from the first image and combines them with the measured values from the second image to produce the volume measurement.

1. Activate the measurement function.

2. Press **OVolume**, and then press **O2PILxDxW** on the 2D-mode measurement LCD.

    The system displays three distances (**D1**, **D2**, **D3**) and a volume (**V**) in the Measured Results.

3. Roll the trackball to position the first measurement marker for the length and then press the **SET** key on the control panel.

    The system displays a second marker and updates the distance value (**D1**).

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

    The system anchors the marker and displays the length (**D1**) in the Measured Results. The system also displays the first marker in the second set of measurement markers on the image screen.

5. Roll the trackball to position the first measurement marker for the depth measurement and then press the **SET** key.

    The system anchors the marker, updates the distance (**D2**), and displays a second marker.

6. Roll the trackball to position the second measurement marker for the depth measurement and then press the **SET** key.

7. On the second image, roll the trackball to position the first measurement marker for the width measurement and then press the **SET** key.

    The system anchors the marker, displays a second marker and updates the distance (**D3**) and volume (**V**).

8. Roll the trackball to position the second measurement marker and then press the **SET** key.

    The system displays the length **(D1)**, depth (**D2**), width (**D3**), and calculated volume (**V**) in the Measured Results.

Ellipse Method

To measure a volume using the Ellipse method, you must take measurements in two separate planes, using two 2D-mode images. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{\pi}{6} \times L_1 \times \frac{4A_1}{\pi L_1} \times \frac{4A_2}{\pi L_2} \, ,$$

where L1 and L2 are the longest dimensions in each plane.

To obtain a two-plane volume using the ellipse method:

Note: The procedure below assumes you have acquired images in Dual-mode. If single 2D-mode images are used, perform the first six steps below on one image. Unfreeze the system. If you press the **ESC** key on the control panel, the system erases the measurements. Acquire and freeze the second image. Press the **CALIPER** key on the control panel, and then perform steps 7 and 8. The system displays the saved values from the first image and combines them with the measured values from the second image to produce the volume measurement.

1. Activate the measurement function.

2. Press **OVolume**, and then press **O2Pl Ellipse** on the 2D-mode measurement LCD.

    The system displays distances (**D1**, **D2**) and area (**A**) for two ellipses and the total volume (**V**) in the Measured Results.

3. Roll the trackball to position the first measurement marker on the axis that is common to both planes and then press the **SET** key on the control panel.

    The system anchors the marker and displays an ellipse. The dotted line represents the axis common to both planes.

4. Roll the trackball to adjust the axis that is common to both planes and then press the **SET** key.

    The system automatically updates the diameter (**D**) and area (**A**) values in the Measured Results.

5. To adjust the shape of the ellipse along the second axis, roll the trackball and then press the **SET** key.

    The system updates the diameter (**D1**, **D2**) and area (**A**) measurements for the ellipse in the Measured Results.

6. Roll the trackball to position the ellipse on the image and then press the **SET** key.

7. On the second image, roll the trackball to position the first measurement marker and then press the **SET** key.

    The system anchors the marker and displays a second marker.

8. Repeat steps 4 through 6 for the second image.

    The system displays the diameters (**D1**, **D2**) and area (**A**) measurements for the second ellipse above the calculated volume (**V**) in the Measured Results.

Trace Method

To measure a two-plane volume using the Trace method, you must use the trackball to outline two structures in two separate planes and identify the axis common to both planes in each structure. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{\pi}{6} \times L_1 \times \frac{4A_1}{\pi L_1} \times \frac{4A_2}{\pi L_2} \ .$$

To obtain a two-plane volume using the trace measurement:

Note: The procedure below assumes you are imaging in Dual mode. If single 2D-mode images are used, perform the first seven steps below on one image. Unfreeze the system. If you press the **ESC** key on the control panel, the system erases the measurements. Acquire and freeze the second image. Press the **CALIPER** key on the control panel then perform steps 8 and 9. The system displays the saved values from the first image, and combines them with the measured values from the second image to produce the volume measurement.

1. Activate the measurement function.

2. Press ❍**Volume**, and then press ❍**2PI Trace** on the 2D-mode measurement LCD.

    The system displays an area (**A**) and distance (**D**) for two traces and the volume (**V**) in the Measured Results.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

    The system anchors the marker and displays a second marker.

4. Roll the trackball to create a trace of the structure.

    Note: You can use the **SELECT** control to delete the trace before completing the circumference. Rotate the **SELECT** control counterclockwise to delete the trace or clockwise to redraw deleted portions of the trace.

5. To complete the trace, press the **SET** key.

    The system displays the area (**A**) of the traced structure in the Measured Results. The system also displays the first measurement marker for identifying the axis common to both planes.

6. Roll the trackball to position the first measurement marker at the beginning of the axis common to both planes and then press the **SET** key.

    The system anchors the marker and displays a second marker.

7. Roll the trackball to position the second measurement marker to indicate the end of the axis and then press the **SET** key.

    The system anchors the second marker and displays the length (**D1**) and area (**A1**) in the Measured Results.

8. On the second image, roll the trackball to position the first measurement marker and then press the **SET** key.

    The system anchors the marker and displays a second marker.

9. Repeat steps 4 through 7 for the second image.

    The system displays the length (**D2**) and area (**A2**) measurements for the second traced structure above the calculated volume (**V**) in the Measured Results.

Thyroid Volume

You can perform Thyroid volume measurements on either two or three images in Dual mode or on two separate 2D-mode images. Thyroid volume requires two image planes and three distance measurements: width, height, and length. The system uses the following formula to calculate the thyroid volume:

VT=WxHxLx0.479cc.

To perform the thyroid volume measurement:

1. Activate the measurement function.

2. Press **⭘Volume**, and then press **⭘Thyroid** on the 2D-mode measurement LCD.

   The system displays a width (**W**), height (**H**), length (**L**), and thyroid volume (**VT**) in the Measured Results.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays the second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker, displays the width (**W**) in the Measured Results, and displays the next measurement marker.

5. Repeat steps 3 and 4 to measure the height (**H**) of the structure.

   If you are in Dual- or Split (B+B) mode, roll the trackball to another frozen image. Otherwise, press the **FREEZE** key on the control panel, scan to obtain another image, and press the **FREEZE** key again. Press the **CALIPER** key on the control panel.

6. Roll the trackball to position the marker for the length and then press the **SET** key.

   The system anchors the marker and displays the second marker.

7. Roll the trackball to position the second marker and then press the **SET** key.

   The system displays the width (**W**), height (**H**), and length (**L**) above the calculated thyroid volume (**VT**) in the Measured Results.

Use the system presets to specify Thyroid as the default 2D-mode measurement method for the Thyroid exam.

Thyroid Volume

Brunn, J., Block, U., Ruf, G., Bos, I., Kunze, W.P., Scriba, P.C. "Volumetry of the Lobe of the Thyroid Gland by Means of Realtime Sonography." Deutsche MedWochenschrift, 106, 1981.

Residual Volume

Use the Residual Volume measurement method to determine a micturated volume by subtracting a post-void volume from a pre-void volume. Values for all three measured volumes display in the Measured Results.

The system uses an LxDxW volume calculation that requires you to position three sets of measurement markers. Measurements are performed on two images acquired in separate scan planes. You can determine a Residual Volume using two single 2D-mode images or images acquired in Dual or 4B mode.

To determine a residual volume:

Note: The procedure below assumes you are imaging in Dual or 4B mode. If single 2D images are used, perform the first five steps below on one image. Unfreeze the system. If you press the **ESC** key, the system erases the measurements. Acquire and freeze the second image. Repeat steps 1 and 2, then begin the procedure with step 6. The system displays the saved values from the first image and combines them with the measured values from the second image to calculate the volumes.

1. Activate the measurement function.

2. Press **◯Volume**, then press **◯Residual** on the LCD.

3. Roll the trackball to position the first measurement marker at the beginning of the distance measurement and then press the **SET** key.

   The system anchors the marker and displays a second measurement marker.

System Reference

System Presets   Ch 3

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F4

M&R
▶ Thyroid
▶ Measurement and
  Report Preset
▶ ▶ Measurement
  Method
▶ ▶ ▶ Default Method
  by Mode

4. Roll the trackball to position the second marker and then press the
    SET key.

    The system anchors the marker and displays the first measurement
    marker of the second set of markers.

5. Repeat steps 3 and 4 to measure a second distance.

    The system displays the values of both distances in the
    Measured Results.

6. On the second image, roll the trackball to position the first measurement
    marker for the third distance and then press the **SET** key.

    The system anchors the marker and displays a second
    measurement marker.

7. Roll the trackball to position the second marker and then press the
    SET key.

    The system displays the width (**W**) below the depth (**D**) and length (**L**)
    measurements. The system also calculates and displays the
    pre-void (**PreV**) volume in the Measured Results.

8. Repeat steps 1 through 7 to determine the post-void volume. If
    performing the measurements on single 2D images rather than in
    Dual or 4B mode, refer to the note at the beginning of the procedure.

    The system calculates the second volume and displays the
    pre-void (**PreV**), post-void (**PostV**), and micturated volumes (**MicV**) in
    the Measured Results. The micturated volume is the difference
    between the pre-void and post-void volumes.

Residual Urine Volume

Rifkin, Matthew D., M.D. "Urinary Bladder Measurements." Chapter 16 in
Atlas of Ultrasound Measurements. B. B. Goldburg and A. B. Kurtz. Chicago:
Year Book Medical Publishers. 1990.

Making a One-Plane Volume Measurement

When measurements made in one plane are used to calculate a volume, the system assumes one measurement to be the same for the second plane. There are three methods for obtaining a one-plane volume:

- 1Pl LxD
- 1Pl Ellipse
- 1Pl Disk

LxD Method

The system calculates one-plane volume using two orthogonal diameter measurements in one plane; the diameter in the second plane is assumed to have the same measurement as the first plane. The system uses the following formula to calculate the volume, based on length and diameter:

$$\text{Volume} = \frac{\left(\pi \times L \times D^2\right)}{6}.$$

The system uses the second measurement (step 5) to determine the value of D2. Therefore, make the second measurement on the axis common to both planes.

To obtain a one-plane volume using the length and diameter method:

1. Activate the measurement function.

2. Press **◐Volume**, and then press **◐1Pl LxD** on the 2D-mode measurement LCD.

   The system displays two distances (**D1**, **D2**) and a volume (**V**) in the Measured Results.

3. Roll the trackball to position the first measurement marker at the beginning of the axis and then press the **SET** key.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker to indicate the end of the axis and then press the **SET** key.

   The system anchors the second marker, updates the length (**D1**), and displays the first measurement marker in the second caliper set.

5. Repeat steps 3 and 4 to measure the common axis.

   When you have completed the second axis measurement, the system displays the length (**D1**), depth (**D2**), and calculated volume (**V**) in the Measured Results.

Ellipse Method

To calculate a one-plane volume using the Ellipse method, perform an area measurement and identify the axis common to both planes. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{\left(8 \times A^2\right)}{3\pi \times L},$$

where L is the axis common to both planes.

To obtain a one-plane volume measurement using an ellipse:

1. Activate the measurement function.

2. Press **⊙Volume**, and then press **⊙1Pl Ellipse** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker on the axis that is common to both planes and then press the **SET** key.

   The system anchors the marker, displays an ellipse, and updates diameters (**D1**, **D2**), area (**A**), circumference (**C**), and volume (**V**) in the Measured Results. The dotted line of the ellipse represents the axis common to both planes.

4. Roll the trackball to adjust the axis that is common to both planes, diameter **D1,** and then press the **SET** key.

5. To adjust the shape of the ellipse along diameter **D2**, roll the trackball and then press the **SET** key.

6. Roll the trackball to position the ellipse on the image and then press the **SET** key.

   The system displays diameters (**D1**, **D2**), area (**A**), circumference (**C**), and volume (**V**) in the Measured Results.

Disk Method

To calculate a one-plane volume using the Disk method, use the trackball to trace a structure and then position an axis line along which the disks will be calculated.

To obtain a one-plane volume using a disk measurement:

1. Activate the measurement function.

2. Press **OVolume**, and then press **O1Pl Disk** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the first marker and activates a second marker.

4. Roll the trackball to create a trace of the structure with the second marker.

5. To complete the trace, press the **SET** key.

   The system draws a line across the structure, signifying the axis along which the disks will be calculated.

6. Roll the trackball to position the axis line and then press the **SET** key.

   The system displays the area (**A**), circumference (**C**), diameter (**D**), and volume (**V**).

General M-Mode Measurements and Calculations

The M-mode measurement function includes distance, heart rate, slope, velocity, and time measurements and calculations for volume flow and ratios.

General Caliper Performance in M-Mode

Note: Press the **FREEZE** key on the control panel before performing a measurement on an M-mode sweep.

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key on the control panel.
Make another measurement	Press the **CALIPER** key on the control panel after the measurement is complete.
Exit the measurement function	Press the **ESC** key or the **FREEZE** key on the control panel to unfreeze the image.

Making a Distance Measurement

The distance measurement, which calculates the length of a straight line between two measurement markers, is the default measurement for M-mode. Use the system presets to change the default measurement method.

To make a distance measurement:

1. Activate the measurement function.

2. Press **◖Distance** on the M-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key to complete the measurement.

   The system automatically updates the distance (**D**) measurement in the Measured Results.

Making a Heart Rate Measurement

Determine the heart rate by delineating one heart cycle with the measurement markers that display as vertical lines.

Note: You can modify the number of heart cycles used to determine a heart rate.

To make a heart rate measurement:

1. Activate the measurement function.

2. Press **OHR** on the M-mode measurement LCD.

   The system displays the first measurement marker.

3. Roll the trackball to position the marker at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker at the end of the cardiac cycle and then press the **SET** key.

   As the marker is moved, the system updates the heart rate (**HR**) and time (**T**) in the Measured Results.

5. To modify the number of heart cycles:

   a. Press the **SELECT** control on the control panel.

   b. Press the **SET** key on the control panel or press **OModify** on the M-mode measurement LCD.

   c. To change the number of heart cycles, rotate the **SELECT** control on the control panel.

      The system displays the number of heart cycles in the Measured Results.

   d. To reposition the measurement marker, roll the trackball and then press **SET**.

Making a Time Measurement

The time method measures the change in time between two points. Time is calculated on the horizontal axis. The measurement markers display as vertical lines.

To make a time measurement:

1. Activate the measurement function.

2. Press **OTime** on the M-mode measurement LCD.

3. Roll the trackball to position the first measurement marker in the image and then press the **SET** key.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   As the marker is moved, the system updates Time (**T**) in the Measured Results.

Making Slope and Velocity Measurements

Slope and velocity both measure the change in distance over time, as determined by two distance measurement markers.

To make a slope or velocity measurement:

1. Activate the measurement function.

2. Press **OSlope** or **OVelocity** on the M-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the marker and displays the second measurement marker.

4. Roll the trackball to position the second marker to the right of the first marker and then press the **SET** key.

   For the slope measurement, the system displays the slope (**S**) in the Measured Results.

   For the velocity measurement, the system displays the distance (**D**), time (**T**), and velocity (**V**) in the Measured Results.

General Doppler Measurements and Calculations

The measurement function on the system includes velocity or frequency, heart rate, and time measurements and calculations for volume, values, and ratios.

General Caliper Performance in Doppler

Note: Press the **FREEZE** key on the control panel before performing a measurement on a Doppler waveform.

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key on the control panel.
Make another measurement	Press the **CALIPER** key on the control panel after the measurement is complete.
Exit the measurement function	Press the **ESC** key or the **FREEZE** key on the control panel to unfreeze the image.

Making a Velocity and/or Frequency Measurement

This measurement is for calculating a velocity or frequency, depending on the Doppler LCD selection. Velocity is the default measurement for Doppler and can also be selected on the LCD. Use the system presets to specify a default measurement method for Doppler.

To measure velocity or frequency:

1. Activate the measurement function.

2. Press **OVelocity** on the Doppler measurement LCD.

3. Roll the trackball to position the measurement marker in the required position and then press the **SET** key.

    The system displays the velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) in the Measured Results as you roll the trackball.

Making a Heart Rate Measurement

Determine the heart rate by delineating one heart cycle with the vertical measurement markers.

Note: You can modify the number of heart cycles used to determine a heart rate.

To measure heart rate:

1. Activate the measurement function.

2. Press **◯HR** on the Doppler measurement LCD.

3. Roll the trackball to position the first measurement marker in the spectrum at the beginning of the cardiac cycle and then press the **SET** key.

    The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker at the end of the cardiac cycle and then press the **SET** key.

    The system updates the time (**T**) and heart rate (**HR**) in the Measured Results as you roll the trackball.

5. To modify the number of heart cycles:

    a. Press the **SELECT** control on the control panel.

    b. Press the **SET** key on the control panel or press **◯Modify** on the Doppler measurement LCD.

    c. To change the number of heart cycles, rotate the **SELECT** control on the control panel.

        The system displays the number of heart cycles in the Measured Results.

    d. To reposition the measurement marker, roll the trackball and then press **SET**.

Making a Time Measurement

The Time method measures intervals between two vertical measurement markers. The system calculates time on the horizontal axis.

To make a time measurement:

1. Activate the measurement function.

2. Press **◯Time** on the Doppler measurement LCD.

3. Roll the trackball to position the first measurement marker in the spectrum and then press the **SET** key.

    The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker in the spectrum.

    The system displays an updating time value (**T**) in the Measured Results as you roll the trackball.

Making a Slope Measurement

Slope measures acceleration or deceleration over time, as determined by two measurement markers: one distance marker and one velocity marker.

To make a slope measurement:

1. Activate the measurement function.

2. Press **○Accel** on the Doppler measurement LCD.

3. Roll the trackball to position the first measurement marker at the beginning of the slope and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker to the right of the first marker, at the ending of the slope you are measuring and then press the **SET** key.

   The system updates the slope (**Accel**), time (**T**), and peak velocity (**Vmx**) measurements in the Measured Results as you roll the trackball.

Calculating the Resistive Index

This measurement is for calculating the resistive index.

To calculate the resistive index:

1. Activate the measurement function.

2. Press **○RI-S/D** on the Doppler measurement LCD.

3. Roll the trackball to position the first measurement marker on peak systole and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker on end diastole and then press the **SET** key.

   The system displays the values for the resistive index (**RI**), peak systole (**PS**), minimum diastole (**MD**), and systole/diastole (**S/D**) in the Measured Results.

Calculating the Pulsatility Index

You can determine the pulsatility index using the following methods:

○PI Auto Trace – a system-generated (automatic) tracing of the spectrum, or

○PI Manual Trace – a user-generated (manual) tracing of the spectrum.

To calculate a pulsatility index using the automatic spectrum tracing:

Note: When you acquire the Doppler spectrum, make sure that the Doppler LCD selection for **○Trace Max** is set to **Full** or **Up**.

1. Activate the measurement function.

2. Press **○PI Auto** on the Doppler measurement LCD.

   The system displays a graphical trace on the spectrum for automatically tracking maximum velocities and displays the first measurement marker on the spectrum.

3. Roll the trackball to position the marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second measurement marker.

4. Roll the trackball to position the second marker and then press the **SET** key.

   The system displays the resistive index (**RI**), pulsatility index (**PI**), peak systole (**PS**), minimum diastole (**MD**), and systole/diastole (**S/D**) in the Measured Results. A time-averaged velocity (**TAmx**) value displays according to the traced interval or segment.

   If the trace drops below the baseline, the system displays a resistive index (**RI**) of 1.0.

To calculate a pulsatility index using the manual spectrum tracing:

Note: When you acquire the Doppler spectrum, make sure the Doppler LCD selections for **◯Trace Mode**, **◯Trace Mean**, **◯Trace Min**, and **◯Trace Max** are set to **Off**.

Note: You can rotate the **SELECT** control on the control panel to delete the trace before completion. Rotate **SELECT** counter clockwise to delete the trace or clockwise to redraw deleted portions of the trace.

1. Activate the measurement function.

2. Press **◯PI Auto**, and then press **◯PI Manual** on the Doppler measurement LCD.

    The system displays the first measurement marker on the spectrum.

3. Roll the trackball to position the marker at peak systole on the Doppler spectrum and then press the **SET** key on the control panel.

    The system anchors the marker and displays a second measurement marker.

4. Roll the trackball to trace one cycle on the waveform and then press the **SET** key.

    The system displays the resistive index (**RI**), the pulsatility index (**PI**), peak systole (**PS**), minimum diastole (**MD**), and the systole/diastole ratio (**S/D**), in the Measured Results. A time-averaged velocity (**TAmx**) value displays according to the traced interval or segment.

Determining Point Values

The Point Value method calculates maximum, minimum, mean, and mode values for any point in time determined by the placement of one measurement marker. The values display in velocity as cm/s or in frequency as kHz, as determined by the Doppler-scale selection.

To calculate point value:

1. Activate the measurement function.

2. Press **OPoint Values** on the Doppler measurement LCD.

3. Roll the trackball to position the measurement marker.

   The maximum (**Vmx**), mean (**Vmn**), mode (**Vmd**) and minimum (**Vmm**) values update in the Measured Results as you roll the trackball.

Determining Average Values

The Average Values measurement is a determination of the time-averaged values for a user-designated segment of the spectrum.

To determine the time-averaged value:

1. Activate the measurement function.

2. Press **OAve Values** on the Doppler measurement LCD.

3. Roll the trackball to position the marker at the beginning of a cycle and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker at the end of a cycle and then press the **SET** key.

   You can also designate multiple cycles.

   The maximum (**TAmx**), mean (**TAmn**), mode (**TAmd**), and minimum (**Tamm**) values update in the Measured Results as you roll the trackball.

Making an Area Flow Volume Measurement

Area flow volume is an estimate of the blood flow volume calculated from the area. Area flow volume requires an area measurement in 2D-mode and a spectral Doppler trace.

Note: Perform the Doppler measurement from peak systole to the next peak systole or from the beginning of the cardiac cycle to the next end diastole.

To perform an area flow volume measurement:

1. Acquire and freeze a 2D-mode/Doppler- or 2D-mode with color/Doppler image and then activate the measurement function.

    The system displays a measurement marker in the spectral Doppler waveform.

2. Press **⭘Flow Volume**, and then press **⭘A-Flow Volume** on the Doppler measurement LCD.

    The system displays a circumference (**C**), area (**A**), time-averaged velocity (**TAV**), and flow volume (**FVol**) in the Measured Results.

3. Roll the trackball to position the measurement marker and then press the **SET** key on the control panel.

    The system displays the second measurement marker.

4. Roll the trackball to position the second measurement marker to the right of the first marker, including as many cardiac cycles as possible and then press the **SET** key.

    The system displays the time-averaged velocity (**TAV**) and the first measurement marker of the second caliper set. Use this caliper set to outline the inner lumen of the cross-sectional vessel in the 2D-mode image.

5. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker, displays an ellipse, and displays the circumference and the area in the Measured Results.

6. Roll the trackball to rotate the first axis and size the ellipse and then press the **SET** key.

7. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

    The system displays the circumference and area of the ellipse in the Measured Results. The ellipse color changes from white to green.

8. Roll the trackball to position the ellipse on the image and then press the **SET** key.

    The system displays measurements for circumference (**C**), area (**A**), time-averaged velocity (**TAV**), and flow volume (**FVol**) in the Measured Results.

Making a Diameter Flow Volume Measurement

Diameter flow volume is an estimate of blood flow volume using the diameter of the vessel. Diameter flow volume requires a vessel diameter measurement in 2D-mode or M-mode and a Doppler velocity trace.

2D-Mode and M-Mode Formulas

The formulas used to compute flow volume differ between the M-mode and 2D-mode measurements. In M-mode, the time-averaged diameter is assumed to be 1/3 Dθ1 + 2/3 Dθ2. In 2D-mode, the diameter measured depends on whether the image is frozen in systole or diastole. Typically, a 10% diameter increase during systole may occur in a pulsatile artery, so the estimated vessel cross-sectional area may vary by 20% from systole to diastole. Thus, M-mode measurements are preferred in measurements of pulsatile arteries if a reasonable angle can be obtained that allows good definition of the vessel walls in the M-mode image. The best angle for these measurements is between 70° and 80°.

Flow volume is determined using the following equation in M-mode:

$$= (5/6)\pi \times \frac{(1/3 \times D\theta1 + 2/3 \times D\theta2)^2}{4} \times TAV \ ,$$

where Dθ1 = M-mode distance measurement multiplied by sin**θ** = Diameter at systole, and

Dθ2 = M-mode distance measurement multiplied by sin**θ** = Diameter at diastole.

The formula assumes blunt flow during systole and parabolic flow during diastole, which results in a beam-width correction factor of 5/6. This factor is also applied to the 2D-mode formula.

2D-Mode Vessel Diameter and Doppler Velocity Trace

You can perform measurements in any sequence.

To perform a diameter flow volume measurement in 2D-mode:

Note: When acquiring the Doppler spectrum, extend the range of the Doppler gate so that it fits just within the vessel of interest. Use the **ANGLE** control to adjust the Doppler angle to be parallel to the blood flow.

Note: You can perform the Doppler measurement from peak systole to the next peak systole or from the beginning of the cardiac cycle to the next end diastole.

1. Acquire and freeze a 2D-mode/Doppler or 2D-mode with color/Doppler image and then activate the measurement function.

   The system displays a Doppler measurement marker in the spectral Doppler waveform.

2. Press **OFlow Volume**, and then press **OD-Flow Volume** on the Doppler measurement LCD.

   The system displays a diameter (**D**), area (**A**), time-averaged velocity (**TAV**), and flow volume (**FVol**) in the Measured Results.

3. Roll the trackball to position the measurement marker and then press the **SET** key on the control panel.

   The system displays the second measurement marker.

4. Roll the trackball to position the second measurement marker to the right of the first marker, including as many cycles as possible, and then press the **SET** key.

   The system displays the time-averaged velocity (**TAV**) and the first measurement marker of the second caliper set. Use this caliper set to determine the diameter of the vessel wall in the 2D-mode image.

5. Roll the trackball to position the first measurement marker on a vessel wall and then press the **SET** key.

   The system anchors the marker and displays a second marker.

6. Roll the trackball to position the second marker on the opposite wall and then press the **SET** key.

   The system displays measured values for the diameter (**D**), area (**A**), time-averaged velocity (**TAV**), and flow volum (**FVol**) in the Measured Results.

M-Mode Vessel Diameter and Doppler Velocity Trace

Because the M-mode measurement line is perpendicular to the transducer and not the vessel, the measured diameters are corrected for the vessel angle relative to the transducer. The angle measured with the Doppler cursor is used as the correction angle.

Important Note: Carefully align the Doppler cursor to obtain an accurate flow volume measurement.

To perform a diameter flow volume measurement in M-mode/Doppler:

Note: When acquiring the Doppler spectrum, extend the range of the Doppler gate so that it fits just within the vessel of interest. Use the **ANGLE** control to adjust the Doppler angle to be parallel to the vessel walls.

Note: You can perform the Doppler measurement from peak systole to the next peak systole or from the beginning of the cardiac cycle to the next end diastole.

1. Acquire and freeze a 2D/M-mode/Doppler image and then activate the measurement function.

    The system displays a Doppler measurement marker in the spectral Doppler waveform.

2. Press **OFlow Volume**, and then press **OD-Flow Volume** on the Doppler measurement LCD.

    The system displays the two diameters (**Dθ1**, **Dθ2**), area (**A**), time-averaged velocity (**TAV**), and flow volume (**FVol**) in the Measured Results.

3. Roll the trackball to position the measurement marker and then press the **SET** key on the control panel.

    The system displays the second measurement marker.

4. Roll the trackball to position the second measurement marker to the right of the first marker, including as many cycles as possible, and then press the **SET** key.

    The system displays the time-averaged velocity and the first measurement marker of the second caliper set. Use this caliper set to determine the diameter of the vessel wall in M-mode.

5. Roll the trackball to position the markers to measure the M-mode diameter in systole and then press the **SET** key to anchor each marker.

    The system displays the first measurement marker of the third caliper set.

6. Roll the trackball to position the markers to measure the M-mode diameter in mid-diastole and then press the **SET** key to anchor each marker.

    The system displays the two diameters (**Dθ1**, **Dθ2**), area (**A**), time-averaged velocity (**TAV**), and flow volume (**FVol**) in the Measured Results.

Report Features

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report.

The system also transfers information from the patient data form into the report. You can annotate the report and edit system-supplied data. You can edit measurements and calculations only if the report includes a worksheet (Cardiac, OB, and Early OB exams).

To access a patient report:

Note: Patient reports are available with the following exam types: **OB**, **Early OB**, **GYN**, **C-Vas**, **P-Vas**, **Venous**, **Ortho**, **EM**, **Cardiac**, and **Urology**.

1. Press **F2** on the keyboard at any time during an exam with a report or roll the trackball to highlight **Report** at the bottom of the Measurement Menu and then press the **SET** key.

   The system displays the patient report.

2. If the patient report has more than one page, roll the trackball to **Prev** or **Next** at the bottom of the report and then press the **SET** key.

3. To redisplay the image screen, press the **ESC** key on the control panel.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.

2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.

2. Use the keyboard to enter data.

[2] Instructions for Use

OB	Ch B2
Cardiac	Ch B6

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the **Comments** field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

    A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

    The system places the phrase in the **Comments** field of the report.

    Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

    The system removes the list of phrases from the screen.

System Reference

System Presets   Ch 3

F4

M&R
▶ Measurement and
  Report Preset
▶▶ Comments Library
    for Report

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

- Press a documentation control on the control panel that is configured for the print function.

  The system transfers the information displayed on-screen to the specified documentation device.

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

- Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

  The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

- To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

System Reference

System Presets   Ch 3
Printer Installation   Ch 5

▤

F4

System Configuration
▶ Peripheral
▶ ▶ RS-232
▶ ▶ USB
▶ Customize Keys

Abdominal, Breast, Thyroid, Testicle, and Surgical Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for the Abdominal, Breast, Thyroid, Testicle, and Surgical exam types. These exam types do not have reports.

Use the system presets to customize each of these exam types.

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display on the LCD for each mode and the order in which they display

Gynecology Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Gynecology exam type. In addition, the system has measurement labels in 2D-mode and Doppler for specific use with the Gynecology exam. Use the system presets to create measurement labels and customize the Gynecology patient report.

Customizing Gynecologic Measurements and Reports

Use the system presets to customize the Gynecological exam.

- Specify the shape, size, and default position for the caliper

- Specify whether the background for the Measured Results section of the screen has a different color than the image background

- Select the default measurement method for each mode

- Select the default method for each type of measurement

- Select the measurement methods that display on the LCD for each mode and the order in which they display

- Select the measurement method for follicle evaluation

- Customize display options such as the presentation of Doppler measurement results on-screen and in the report and the enabling of operator and referring physician information for the patient report

- Establish user-defined labels for 2D-mode and Doppler

- Define the Comments Library for the patient report

- Enable access through the Measurement Menu to Early OB measurements and calculations and to the Early OB worksheet and report.

[2] Instructions for Use

General Measurements:
2D-mode	B1-16
M-mode	B1-34
Doppler	B1-37

Exam-specific:
Follicle	B1-54

System Reference

System Presets   Ch 3

▤

F4

M&R
▶ Measurement and Report Preset

A brief overview of the setup screens is provided in this section.

Measurement and Report Preset : GYN	Description
Measurement Method	Select the default measurement method for 2D-mode, M-mode, and Doppler and the default method for each type of measurement.
Customize General Measurement LCD	Identify LCD labels to use with the general measurement LCD page for 2D-mode, M-mode, and Doppler.
Measurement Order	Specify the order of appearance for labels in the Measurement Menu under tabs for 2D-mode and Doppler. You can mix user-defined labels with system-defined labels in any order. Also select the measurement method for follicle evaluation.
Display Item	Designate Doppler measured results to display for the GYN exam on-screen and in the report. Activate abbreviated display of measured results. Enable Early OB measurements.
User-Defined Label	Establish labels for use in the measurement function with the GYN exam. Six labels are allowed: three for 2D-mode and three for Doppler. Add user-defined labels to the Measurement Menu with the Measurement Order screen.
Comments Library for Report	Enter up to five selectable phrases for inclusion into a report. Each phrase can include up to 69 characters.

Gynecology ▪ Measurement Menu

The Gynecology exam Measurement Menu displays on the left side of the image screen when the measurement function is active. The menu indicates which measurement method is currently in use. It also contains system-defined measurement labels and any user-defined measurement labels.

Use the system presets to enable access through the Measurement Menu to Early OB measurements and calculations and to the Early OB worksheet and report.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Display Item

[2] Instructions for Use

Early OB   Ch B2

Gynecology ▪ 2D-Mode Measurement Labels

In addition to system-defined 2D-mode measurement labels, you can define up to three 2D-mode measurement labels. These labels display in the Measurement Menu and in the patient report with the measured result, when assigned.

Measurement Label	Description	Measurement Method Options
Uterus **Length** **Depth** **Width**	Measurements of the uterus.	**Distance**
Endometrium **Cervix**	Thickness of the endometrium Length of the cervix	**Distance** **Distance**
Lt Ovary **Length** **Depth** **Width**	Measurements of the left ovary. The system automatically calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	**Distance**
Rt Ovary **Length** **Depth** **Width**	Measurements of the right ovary. The system automatically calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	**Distance**
Lt Follicle **#1-15**	Measurements of the left ovarian follicle. The system transfers labeled values for follicle measurements into the patient report.	Method selected in the system presets.
Rt Follicle **#1-15**	Measurements of the right ovarian follicle. The system transfers labeled values for follicle measurements into the patient report.	Method selected in the system presets.
xxxx	A user-defined label. You can define up to three 2D-mode measurement labels to correspond to a measurement method. Four measurement methods are available: distance, area, circumference, and volume.	The 2D-mode measurement method assigned in the system presets.

Follicle Measurements

Before taking a follicle measurement, select one of the following measurement methods in the system presets to customize the Gynecology exam:

- **Distance**

- **2DistAve** – an average of two distance measurements

- **3DistAve** – an average of three distance measurements

- **Area**

- **Circumference**

- **Volume**

The system transfers labeled values for follicle measurements into the patient report.

To perform a follicle measurement:

1. Activate the measurement function.

2. If necessary, access the page in the Measurement Menu containing the **Lt Follicle** and **Rt Follicle** measurements.

3. Roll the trackball to select the appropriate **Lt Follicle #** or **Rt Follicle #** in the Measurement Menu and then press the **SET** key.

   The system activates the follicle measurement method selected in the system presets and displays the first measurement marker in the image area.

4. Roll the trackball to position the first measurement marker to the beginning point and then press the **SET** key.

5. Perform the measurement according to the activated method.

   The system assigns the measurement value to the selected follicle number and transfers the values to the patient report.

6. Repeat steps 3 through 5 for each follicle.

Gynecology ▪ Doppler Measurement Labels

In addition to system-defined Doppler measurement labels, you can define up to three user-defined Doppler measurement labels. These labels display in the Measurement Menu and in the patient report with the measured result, when assigned.

[2] Instructions for Use

General Measurements:
  Doppler   B1-37

Measurement Label	Description	Measurement Method Options
Lt. Ut.	Left Uterine Artery	**RI-S/D** for RI **Velocity** for determining Systole and Diastole
Rt. Ut.	Right Uterine Artery	**RI-S/D** for RI **Velocity** for determining Systole and Diastole
Lt. Ov.	Left Ovarian Artery	**RI-S/D** for RI **Velocity** for determining Systole and Diastole
Rt. Ov.	Right Ovarian Artery	**RI-S/D** for RI **Velocity** for determining Systole and Diastole
xxxx	A user-defined label. You can define up to three measurement labels.	The system assigns the default measurement method set in system presets to each label.

Gynecology Patient Report

The Gynecology exam has a one-page patient report. The system transfers labeled measurements from the Gynecology Measurement Menu on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate the report.

Use the system presets to select measurements to be included in the Gynecology patient report. The unit of measure for **Follicles** depends on the measurement method selected in the system presets. 2DistAve is the system default.

To access the Gynecology patient report:

1. During a GYN exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

    The system displays the **Data** tab of the Gynecology patient report.

2. Roll the trackball to the **Description** tab and then press the **SET** key.

3. To redisplay the image screen, press the **ESC** key or roll the trackball to **Return** at the bottom of the report and then press the **SET** key.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.

2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.

2. Use the keyboard to enter data.

Gynecology Data Tab

The first tab of the Gynecology patient report contains information entered on the patient data form for the GYN exam type. The Data tab may contain measurement details for 2D-mode and Doppler if abbreviated display of results has not been selected in the system presets.

System Reference

System Presets   Ch 3

📄
F4

M&R
▶ Measurement and
  Report Preset
▶▶ Measurement Order
▶▶▶ Follicle
      Measurement
      Method

System Reference

System Presets   Ch 3

📄
F4

M&R
▶ Measurement and
  Report Preset
▶▶ Display Item

Gynecology Description Tab

The second tab of the Gynecology patient report contains drop-down boxes with descriptive data. Selections are shown below.

Report Item	Selections
Uterus	**WNL** **Fibroid** **Atrophic** **Septated** **Bicornuate**
Right Adnexa	**WNL** **Absent** **Mass** (blank)
Left Adnexa	**WNL** **Absent** **Mass** (blank)
Cul-de-Sac	**WNL** **Fluid Seen** **No Fluid Seen**
Uterine Mass	**None** **Calcification(s)** **Solid** **Complex** **Cystic** **Yes**
Right Ovary	**WNL** **Absent** **Not Seen**
Left Ovary	**WNL** **Absent** **Not Seen**

Orthopedic Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Orthopedic exam type. In addition, the Orthopedic exam has a calculation for **Hip Angle**. Hip Angle is an angle calculation designed for examination of infant hips. The Orthopedic exam also has specific 2D-mode measurement labels and a Sonographic Infant Hip Classification patient report.

Use the system presets to customize the Orthopedic exam.

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display on the LCD for each mode and the order in which they display
- Customize display options and enable operator and referring physician information for the patient report
- Define the Comments Library for the patient report

Orthopedic ▪ 2D-Mode Measurement Labels

The following describes measurement labels for 2D-mode measurements when the Orthopedic exam is active. These labels display in the Measurement Menu.

Measurement Label	Description	Measurement Method Options
R Hip Angle	Right hip angle	Hip Angle
L Hip Angle	Left hip angle	Hip Angle

Measuring a Hip Angle

The Hip Angle measurement requires the placement of three intersecting lines to determine two angles. The first line is called the ***reference line***. The second line establishes the alpha angle (α), and the third line establishes the beta angle (β). The system calculates and displays angles α and β.

To measure a hip angle:

1. Activate the measurement function.

2. Roll the trackball to **R Hip Angle** in the Measurement Menu and then press the **SET** key on the control panel.

3. Roll the trackball to position the first marker at point a and then press the **SET** key.

    The system anchors the marker and displays a second marker.

4. To define the direction of the reference line, roll the trackball to position the second marker so that the line intersects point b and then press the **SET** key.

    The system anchors the reference line and displays a new marker.

5. To create the line for the alpha **(α)** angle:

    a. Roll the trackball to position the marker at point c and then press the **SET** key.

    The system anchors the marker and displays a new marker.

    b. To draw the alpha **(α)** angle line, roll the trackball so that the line intersects point d and then press the **SET** key.

    The system anchors the line and displays a new marker.

6. To create the line for the beta **(β)** angle:

    a. Roll the trackball to position the marker at point e and then press the **SET** key.

    The system anchors the marker and displays a new marker.

    b. To draw the beta **(β)** angle line, roll the trackball so that the line intersects point f and then press the **SET** key.

    The system anchors the line and displays the **α** angle and **β** angle in the Measured Results and the Graf sonometer.

7. Roll the trackball to **L Hip Angle** in the Measurement Menu and then press the **SET** key. Repeat steps 3 through 6.
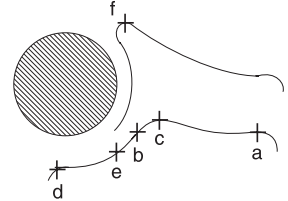
Points a and b define the reference line. Points c and d establish the line used for the α angle, and points e and f establish the line used for the β angle.
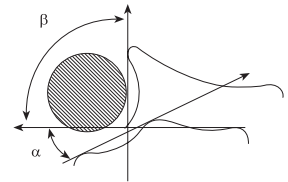
Orthopedic Report

The Orthopedic exam has a one-page report for the Sonographic Infant Hip Classification.

To access the patient report:

1. During an Orthopedic exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

2. To redisplay the image screen, press the **ESC** key or roll the trackball to **Return** at the bottom of the report and then press the **SET** key.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.

2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.

2. Use the keyboard to enter data.

Orthopedic ▪ Descriptive Data

The patient report contains drop-down boxes with descriptive data
Selections are shown below.

Report Item	Selections (right)	Selections (left)
Osseous Profile	(Blank) **I : Good** **II : Deficient** **D : Deficient** **III : Poor** **IV : Poor**	(Blank) **I : Good** **II : Deficient** **D : Deficient** **III : Poor** **IV : Poor**
Osseous Acetabulum	(Blank) **I : Sharp** **II : Round** **D : Round/Flat** **III : Flat** **IV : Flat**	(Blank) **I : Sharp** **II : Round** **D : Round/Flat** **III : Flat** **IV : Flat**
Cartilaginous Acetabulum	(Blank) **I : Narrow** **II : Wide/Overlapped** **D : Everted** **III : Everted Echo Free** **III : Everted Echo Poor** **IV : Everted**	(Blank) **I : Narrow** **II : Wide/Overlapped** **D : Everted** **III : Everted Echo Free** **III : Everted Echo Poor** **IV : Everted**
Type	(Blank) **Ia** **Ib** **IIa** **IIb** **IIc** **IIIa** **IIIb**	(Blank) **Ia** **Ib** **IIa** **IIb** **IIc** **IIIa** **IIIb**

Orthopedic References

Hip Angle

Graf R. "Sonographic Diagnosis of Hip Dysplasia and Hip Dislocation."
Revised by R. Graf from reprint. Schuler P. Graf R. 1986. "Sonographie in de
Orthopädie in Braun — Günther — Schwerk." Ultraschalldiagnostick 4. Erg.
Lig 7, 1986. Ecomed Verlag.

Cranial Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for the Cranial exam type. In addition to the general 2D-mode selections, the system has Area Percent Stenosis and Diameter Percent Stenosis measurements specific to the Cranial exam. The Cranial exam type does not have a report.

Use the system presets to customize the Cranial exam.

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display on the LCD for each mode and the order in which they display

Determining an Area Percent Stenosis

The Area Percent Stenosis calculation compares cross-sectional areas of the same vessel. The system automatically performs the calculation using the following formula after you position two ellipses over the same vessel.

$$\textbf{Area \% Stenosis} = \left(\frac{A1 - A2}{A1} \right) \times 100 \, ,$$

where A1 = the larger area, A2 = the smaller area.

To determine an area percent stenosis:

1. During a Cranial exam, freeze the image and activate the measurement function.

2. Press **O%Stenosis**, and then press **OA-%Stenosis** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker, displays an ellipse, and displays the area in the Measured Results.

4. Roll the trackball to rotate the first axis and size the ellipse and then press the **SET** key.

5. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

   The system displays the area of the ellipse in the Measured Results. The ellipse color changes from white to green.

6. Roll the trackball to position the ellipse on the image and then press the **SET** key.

7. Unfreeze the image, and acquire and freeze a second image. Reactivate the measurement function. If you press the **ESC** key, the system erases the measurements.

   The system automatically reselects **OA-%Stenosis** on the LCD.

8. For the second ellipse, repeat steps 3 through 6.

   The system displays the areas for the two ellipses (**A1**, **A2**), and the calculated area percent stenosis (**%Sten**) in the Measured Results.

Determining a Diameter Percent Stenosis

The Diameter Percent Stenosis calculation compares diameters of the same vessel. The system automatically determines the calculation using the following formula after you obtain two diameters of the same vessel.

$$\text{Diameter \% Stenosis} = \left(\frac{D1 - D2}{D1}\right) \times 100,$$

where D1 = larger diameter, D2 = smaller diameter.

To determine a diameter percent Stenosis:

1. During a Cranial exam, freeze the image and activate the measurement function.

2. Press **O%Stenosis**, and then press **OD-%Stenosis** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker and displays the first diameter (**D1**) in the Measured Results.

5. Unfreeze the image, and acquire and freeze a second image. Reactivate the measurement function. If you press the **ESC** key, the system erases the measurements.

   The system automatically reselects **OD-%Stenosis** on the LCD.

6. Repeat steps 3 and 4 for the second diameter (**D2**).

   The system anchors the measurement marker and displays the diameters (**D1**, **D2**) and calculated diameter percent stenosis (**%Sten**) in the Measured Results.

B2 Obstetrical Measurements and Calculations

Obstetrical Measurements and Calculations

The ultrasound system has two exam types for the Obstetrical (OB) application, the **Early OB** exam and the **Standard OB** exam. Both exams use formulas for estimating menstrual age, estimating fetal weight, and determining growth ratios. Parameter labels are assigned to measured results used as parameters in these formulas. Each exam also supports multiple gestation studies.

- The **Early OB** exam is intended for **first trimester studies** and has measurement and parameter labels for use in 2D-mode.

- The **Standard OB** exam is intended for **second and third trimester studies** and has measurement and parameter labels for use in 2D-mode, including a label for the **Amniotic Fluid Index**. The system provides fetal heart measurements for use in all imaging modes, and an umbilical artery measurement for use in Doppler.

The OB exams also have the capability for generating **Growth Analysis Graphs** for each OB exam. Growth Analysis compares actual fetal growth to predicted growth patterns. Graphs can display measured results from a single exam, or from data acquired over a series of exams and combined using the **Link Files** function.

All general measurements and calculations are available for the Obstetric exam type. The results of the measurements and calculations can be used to determine an estimated menstrual age and/or estimated fetal weight. These estimations are based upon *standard* or *user-defined* tables or formulas. Standard tables or formulas are system-defined, while a user-defined table or formula contains data that you have entered using the system presets.

Customizing Obstetrical Measurements and Reports

Use the system presets to customize the OB exam.

- Specify which labels display in the Measurement Menu and the order in which they display

- Select the default references for tables and formulas provided by the system

- Designate a method, direct or average, for determining parameter values

- Customize the content of the patient report

- Create user-defined labels for 2D-mode and D-mode measurements

- Define up to five tables and/or formulas to estimate menstrual age

- Define up to five formulas to estimate fetal weight

- Define up to five tables and/or formulas for growth analysis

- Define up to five formulas for ratios of parameters

A brief overview of the setup menus for the OB exams is provided in this section.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ Measurements and
  Report Preset
▶ ▶ Item and
    Reference Selection
▶ ▶ Display Item/Display
    Configuration
▶ ▶ User-Defined

System Presets for Customizing Obstetrical Measurements, Calculations, and Reports	Description of Secondary Menu
Item and Reference Selection	Specify which labels display in the Measurement Menu and the worksheet and the order in which they display. The selected labels display along with assigned values in the Measured Results and the patient report. Use the **Display Item**/**Display Configuration** checkboxes (see below) to determine whether the labels display when no values are assigned to them.
	Add user-defined 2D-mode and Doppler measurement labels to the list of displayed labels.
	Assign a reference for each parameter and calculation on which tables and formulas are based.
	Assign a method, **Direct** or **Average**, for determining the value for a parameter or calculation that displays in the worksheet and in the patient report. In the Direct method, the system displays the last value assigned to a measurement label. In the Average method, the system performs an average of the values as each value is assigned to the label and displays the calculated average.
Display Item or **Display Configuration**	If you select the **Abbreviated Display of Results** checkbox, the system displays in the Measured Results and the patient report only the measurement labels to which you have assigned values. If the checkbox is not selected, the system displays all the measurement labels specified in the **Item and Reference Selection** (see above).
	Activate or deactivate the display of measurement results for Doppler and the display of the physician ID and referring physician ID.
	Select **HC with BPD/OFD** to automatically derive values for BPD and OFD from the HC measurement. Select **AC with ATD/ASD** to automatically derive values for ATD and ASD from the AC measurement. These selections determine whether values for the two axes are included in the patient report.
Customize Growth Analysis Graphs	Select the display format, **Single** or **Quad**, for the graphs. Up to 12 graphs are available, as 12 pages in Single display format or three pages in Quad display format.
	Select **Current** or **Previous** data, or both, to display in the graphs.

System Presets for Customizing Obstetrical Measurements, Calculations, and Reports	Description of Secondary Menu
Measurement Label	Establish up to five user-defined labels for 2D-mode and up to five user-defined labels for Doppler for use with the Measurement function when the Early or Standard OB exam is active. Measurement labels appear in the Measurement Label menu, but do not display an estimated menstrual age.
	Measurement labels can be used in menstrual age tables, in formulas for estimating composite menstrual age and fetal weight, and in tables and formulas for growth analysis graphs.
MA Data	Define up to five tables and/or formulas to estimate menstrual age.
GA Data	Define up to five tables and/or formulas for growth analysis.
EFW Formula	Define up to five formulas to estimate fetal weight.
Ratio Formula	Define up to five formulas for ratios of parameters.

Tables, Formulas, and Calculations to Estimate Fetal Weight and Menstrual Age

Use the system presets to select references for the tables and formulas used by the ultrasound system to calculate an estimated menstrual age and estimated fetal weight. You can also change a reference in the OB worksheet.

Estimated Fetal Weight Formulas

Use the system presets or the worksheet to designate the references (authors) for the formulas that the system uses in determining estimated fetal weights (**EFW1** and **EFW2**). You can also use the system presets to create up to five user-defined formulas for **EFW**.

Note: The calculation and display of an estimated fetal weight is dependent on the valid ranges specified by the author of an equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

EFW1 and **EFW2** display in the worksheet and the patient report. **EFW1** also displays in the Measured Results after the measurements required by the designated author are made.

Menstrual Age Tables and Formulas

You can designate the reference (author) for the table or formula that the system uses in determining an estimated menstrual age. Tables are available for the following parameters.

BPD, **OFD**, **FTA**, **EFW**, **AXT**, **HC**, **ASD**, **ATD**, **AC**, **FL**, **HL**, **UL**, **BN**, **TL**, **FT**, **MSD**, **CRL** and **GS**. The system provides an estimated menstrual age based on estimated fetal weight if the Tokyo, Osaka, or JSUM reference is selected for EFW1 or EFW2.

You can also use the system presets to create up to five user-defined menstrual age tables or formulas for system- and user-defined measurements.

Menstrual Age

Use **Item and Reference Selection** in the system presets to select the method that the system uses to estimate menstrual age for a parameter.

- **Direct** estimates a menstrual age from the most recent measurement obtained for a parameter.
- **Average** estimates menstrual age by averaging as many as five measurements obtained for a parameter. The worksheet displays the values used to calculate the average.

Composite Menstrual Age

Use the system presets or the worksheet to select the method that the system uses for calculating a composite ultrasound menstrual age (**USMA**). The options are *average*, one of Hadlock's eleven *regression equations*, or a *user-defined formula*.

The basis for an *average* is the estimated menstrual ages obtained from any combination of parameters. To obtain an average, the system adds the estimated menstrual ages, then divides the sum by the number of measured parameters.

Hadlock's eleven *regression equations* require the measurement of one or more of the following parameters: **BPD**, **HC**, **FL**, or **AC**. The required parameters display below the USMA drop-down list in the **EFW/USMA** tab.

Use **MA Data** in the system presets to define a *user-defined formula* for composite menstrual age.

F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Item and
    Reference Selection
▶ ▶ ▶ EFW/USMA tab
▶ ▶ MA Data

Indicating a Single or Multiple Study

Both the Early OB and the Standard OB exams support multiple gestational studies, providing separate measurement information for each fetus.

You can change the type of study when the Measurement function is active.

To indicate a multiple study during measurements:

1. Roll the trackball to highlight **Single** at the top of the Measurement Menu and then press the **SET** key.

   The system displays a confirmation message.

   Note: You cannot change back from a multiple-gestational study to a single-gestational study. To continue imaging on a single fetus, roll the trackball to position the pointer on the **Cancel** button and then press the **SET** key.

2. To change to a multiple-gestational study, roll the trackball to position the pointer on the **OK** button and then press the **SET** key.

   The system displays **Fetus A** at the top of the Measurement Menu and assigns the labeled measurement values already acquired in the current exam to Fetus A in the worksheet and the patient report.

3. Continue imaging for Fetus A or, to begin measurements on another fetus, roll the trackball to highlight **Fetus A** at the top of the Measurement Menu and then press the **SET** key.

Single
BPD
OFD
HC
ASD

Example single-gestation OB Measurement Menu.

Fetus A
BPD
OFD
HC
ASD

Example multiple-gestation OB Measurement Menu.

Obstetrics ▪ Measurement Menu

When the Measurement function is activated during an OB exam, the system displays the Measurement Menu on the left side of the image screen.

At the top of the menu, the system displays **Single** or, in the case of a multiple pregnancy, the label assigned to the measurements currently being made: **Fetus A**, **Fetus B**, or **Fetus C**.

The OB exam can display over 30 measurement and parameter labels on different pages of the Measurement Menu. At the bottom of the menu the system displays the number of the current page, such as **1/3**. To access the next page of labels, rotate the **SELECT** control when the Measurement Menu is highlighted or roll the trackball to highlight the page number and then press the **SET** key.

You can make fetal heart measurements in all imaging modes. To access the measurement labels for the current mode, roll the trackball to highlight **Fetal Heart** and then press the **SET** key.

The Measurement Menu also provides access to the patient report, worksheet, and OB growth curve graphs. Roll the trackball to highlight the label and then press the **SET** key.

The Measurement Label menu contains system-defined parameter and measurement labels, as well as any user-defined measurement labels.

The ***Clinical menstrual age (MA)*** displays at the top of the Measured Results. The Clinical MA is the menstrual age based on the clinical last menstrual period (LMP) entered in the patient data form or as updated in the worksheet or in the patient report.

For MA parameter labels, a **Calculated MA** displays in the Measured Results next to each label to which a measured result is assigned.

```
Distance
Single
  BPD
▌ OFD
  HC
  ASD
  ATD
  AC
  FL
  HL
  UL
  BN
  TL
  FT
  CL
Fetal Heart
Report
Worksheet
Graph
     1/3
```

Example list of 2D-mode measurement labels for OB.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement, then assign the measured value to a label — *Measure then Label* — or select a label and then use the default measurement method for the selected label to perform the measurement — *Label then Measure*.

To view the labeled values in the patient report, press the **F2** key on the keyboard or select **Report** in the Measurement Menu during the measurement function.

To measure then label:

Note: Use the system presets to customize the system to display a measurement marker in the image when you activate the measurement function.

1. Complete the measurement by pressing the **SET** key.

2. Roll the trackball to highlight a label in the Measurement Menu and then press the **SET** key.

    The system assigns measured results to the selected label.

To label then measure:

Note: Use the system presets to customize the system to highlight the Measurement Menu when you activate the measurement function.

1. Roll the trackball to highlight the desired label in the Measurement Menu and then press the **SET** key.

    The system activates the default measurement method for the selected label and displays it at the top of the Measurement Menu.

2. Complete the measurement using the default measurement method.

    The system assigns the measured results to the selected label.

---

[2] Instructions for Use

Measurement
Procedures   Ch B1

System Reference

System Presets   Ch 3

📄
F4

M&R
▶ Measurement and
Report Preset
▶▶ Display Item/Display
Configuration

📄
F4

M&R
▶ Caliper Default
Position

Early OB ▪ 2D-Mode Parameter, Measurement, and Calculation Labels

The 2D-mode labels for the Early OB exam are described in this section.

Early OB ▪ Parameter Labels

The following parameter labels for 2D-mode are used to estimate menstrual age. Parameter labels display in the Measurement Menu, the worksheet, and the patient report. When assigned measured results, parameter labels display an estimated menstrual age (MA) if the measured result is within the range of measurements in the reference table.

MA Parameter Label	Description	Measurement Method
CRL	Crown Rump Length	Distance
BPD	Biparietal Diameter	Distance
MSD	Mean Gestational Sac Diameter	Distance
AC	Abdominal Circumference	Ellipse
HC	Head Circumference	Ellipse
ASD	Abdominal Sagittal Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
ATD	Abdominal Transverse Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
FL	Femur Length	Distance
HL	Humerus Length	Distance
UL	Ulna Length	Distance
BN	Binocular Distance	Distance
TL	Tibia Length	Distance
FT	Foot Length	Distance
OFD	Occipital Frontal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
GS	Gestational Sac. Maximum length.	Distance
FTA	Fetal Trunk Area	Ellipse
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system setups.

Early OB ▪ Measurement Labels

Measurement labels display on the Measurement Menu, the worksheet, and
the patient report, but do not display an estimated menstrual age.
User-defined labels and their accompanying measured results display as
specified in the **Item and Reference Selection** menu of the system presets.

Measurement Label	Description	Measurement Method Option
Yolk Sac	Yolk Sac Diameter	Distance
NT	Nuchal Thickness	Distance
APTD	Anteroposterior Trunk Diameter	Distance
TTD	Transverse Trunk Diameter	Distance
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Early OB ▪ Calculation Labels

The following calculation labels for 2D-mode are available when the Early OB
exam is active. Calculation labels do not display in the Measurement Menu.
The system performs the calculations once the required measurements are
made, displays the calculated values in the Measured Results, and then
transfers the values to the worksheet and the patient report.

Calculation Label	Description	Required Measurements
CLINICAL MA	Menstrual Age by last menstrual period	Calculated from the LMP date.
CLINICAL EDC	Estimated Date of Confinement	Determined by LMP date.
US MA	Composite Menstrual Age by ultrasound	Determined from all Menstrual Age parameters and calculations.
US EDC	Estimated Date of Confinement by ultrasound	Determined from all ultrasound parameters and calculations.
EFW1 and **EFW2**	Estimated Fetal Weight	The required measurements vary depending on the selected references (authors).
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	APTD TTD

Early OB ▪ M-Mode and Doppler Parameter, Measurement, and Calculation Labels

The following is a description of a calculation label for M-mode and Doppler measurement when the OB exam is active. This label displays in the Measurement Menu.

M-mode Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One cardiac cycle in M-mode or Doppler

You can select the **FHR** measurement label and then follow the system-guided sequence. Or, you can select the measurement method on the LCD, perform the measurement, and then assign the measured result to the label.

Standard OB ▪ 2D-Mode Parameter, Measurement, and Calculation Labels

The labels for the Standard OB exam are described in this section.

The Standard OB exam displays over 30 measurement and parameter labels on different pages of the Measurement Menu. The default arrangement places parameter labels on the first page and measurement labels on the second and third pages. Use the system presets to specify which labels display in the Measurement Menu and the order in which they display.

System Reference

System Presets   Ch 3

▤

F4

M&R
▶ Measurements and
   Report Preset
▶ ▶ Item and
      Reference Selection

Standard OB ▪ Parameter Labels

The following parameter labels for 2D-mode are used to estimate menstrual age. Parameter labels display in the Measurement Label menu and in the patient report, including the worksheet. When assigned measured results, parameter labels display an estimated menstrual age.

MA Parameter Label	Description	Measurement Method
BPD	Biparietal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
OFD	Occipital Frontal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
HC	Head Circumference	Ellipse
ASD	Abdominal Sagittal Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
ATD	Abdominal Transverse Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
AC	Abdominal Circumference	Ellipse
FL	Femur Length	Distance
HL	Humerus Length	Distance
UL	Ulna Length	Distance
BN	Binocular Distance	Distance
TL	Tibia Length	Distance
FT	Foot Length	Distance
FTA	Fetal Trunk Area	Ellipse
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Standard OB ▪ Measurement Labels

Measurement labels display in the Measurement Menu, the worksheet, and the patient report but do not display an estimated menstrual age. User-defined labels and their accompanying measured results also display on the worksheet and the patient report.

Measurement Label	Description	Measurement Method
TC	Thoracic Circumference	Ellipse
Right RL	Renal Length Right	Distance
Left RL	Renal Length Left	Distance
Right RAP	Renal Dimension Anterior-Posterior Right	Distance
Left RAP	Renal Dimension Anterior-Posterior Left	Distance
CL	Clavicle Length	Distance
AFI	Amniotic Fluid Index	Distance
NT	Nuchal Thickness	Distance
HW	Hemispheric Width	Distance
TCD	Transcerebellar Diameter	Distance
LVW	Lateral Ventricle Width	Distance
Cist mag	Cisterna Magna (Posterior Fossa)	Distance
Cervix Len	Cervical Length	Distance
Umb VD	Umbilical Vein Diameter	Distance
APTD	Anteroposterior Trunk Diameter	Distance
TTD	Transverse Trunk Diameter	Distance
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Fetal Cardiac Measurement Label	Description	Measurement Method
AoD Arch	Aortic Arch Diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance

Standard OB ▪ Calculation Labels

The following calculation labels for 2D-mode are available when the OB exam is active. Calculation labels do not display in the Measurement Menu. The system performs the calculations after the required measurements are made, displays the calculated values in the Measured Results, and then transfers the values to the worksheet and the patient report. The system displays a range of values for a ratio based on the LMP or IVF date; the calculated value is in range or out of range relative to the clinical MA.

Calculation Label	Description	Required Measurements
TCD/AC	Ratio of Transcerebellar Diameter to Abdominal Circumference	TCD AC
LVW/HW	Ratio of Lateral Ventricular Width to Hemispheric Width	LVW HW
AFI	Amniotic Fluid Index. Sum of four distance measurements made on four different images.	Distance
FL/AC	Ratio of Femur Length to Abdominal Circumference	FL AC
HC/AC	Ratio of Head Circumference to Abdominal Circumference	HC AC
FL/BPD	Ratio of Femur Length to Biparietal Diameter	FL BPD
CI	Cephalic Index Short axis / long axis * 100	BPD OFD
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	APTD TTD
CORBPD	BPD corrected by a formula to adjust the head shape	BPD
EFW1, **EFW2**	Two displays for estimated fetal weight	The required measurements vary depending on the selected reference (author).
CLINICAL MA	Menstrual Age by last menstrual period	Calculated from the LMP date
CLINICAL EDC	Estimated Date of Confinement	Determined by LMP date
US MA	Composite Menstrual Age by ultrasound	Determined from all Menstrual Age parameters and calculations.
US EDC	Estimated Date of Confinement by ultrasound	Determined from all ultrasound parameters and calculations

Fetal Cardiac Calculation Label	Description	Required Measurements
FS%	Percentage of Fractional Shortening FS%=(LVIDd – LVIDs)/LVIDd*100	LVIDd LVIDs

Standard OB ▪ M-Mode Parameter, Measurement, and Calculation Labels

The following table shows a description of a calculation label for M-mode measurement when the OB exam is active. This label displays in the Measurement Menu.

Fetal Cardiac Measurement Label	Description	Measurement Method
AoD Arch	Aortic Arch Diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance

M-mode Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One cardiac cycle in M-mode

Fetal Cardiac Calculation Label	Description	Required Measurements
FS%	Percentage of Fractional Shortening $FS\% = (LVIDd - LVIDs)/LVIDd * 100$	LVIDd LVIDs

Standard OB ▪ Doppler Measurement Labels

In addition to the system-defined Doppler measurement label, you can define up to three Doppler measurement labels. These labels display in the Measurement Menu and the Standard OB Report, when assigned to a measured result.

Measurement Label	Description	Required Measurements
Umb A	Umbilical Artery	RI(S/D), PI, S, or D
MCA	Middle Cerebral Artery	RI(S/D), PI, S, or D
User-Defined #1-5	A user-defined label. You can define up to five measurement labels to correspond to a measurement method.	The Doppler measurement method assigned by the system

Fetal Cardiac Measurement Label	Description	Measurement Method
Ao Arch Vmax	Aortic Arch Velocity maximum	Velocity
Asc Ao Vmax	Ascending Aorta Velocity maximum	Velocity
DA Vmax	Ductus Arteriosus Velocity maximum	Velocity
Desc Ao Vmax	Descending Aorta Velocity maximum	Velocity
LVET	Left Ventricular Ejection Time	Time
LVOT Vmax	Left Ventricular Outflow Tract Velocity maximum	Velocity
PA	Pulmonary Artery	Velocity
RVET	Right Ventricular Ejection Time	Time
RVOT Vmax	Right Ventricular Outflow Tract Velocity maximum	Time

Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One cardiac cycle in Doppler

Determining an Amniotic Fluid Index

Use the Amniotic Fluid Index (AFI) measurement method to calculate an index for amniotic fluid volume. This method requires a distance measurement made in each of the four quadrants, using four separate images.

The procedure can be performed in 2D-mode, Dual mode, or 4B-mode. If 2D-mode is used, a new image must be acquired for each measurement. If Dual mode is used, one measurement can be made on each of the first two images and new images must be acquired for the last two measurements.

To measure an Amniotic Fluid Index:

1. During an OB exam, activate the Measurement function.

2. Roll the trackball to select **AFI** in the Measurement Menu and then press the **SET** key.

3. Roll the trackball to position the first measurement marker and then press the **SET** key.

    The system anchors the marker and displays the second marker.

4. Roll the trackball to position the second marker and then press the **SET** key.

    The system anchors the marker and displays the distance value in Measured Results.

5. Obtain additional images as required and perform steps 1 through 4 for each image until all four quadrants are measured.

    The system displays the distance value (**D**) for each quadrant. When the fourth measurement is complete, the system calculates the amniotic fluid index (**AFI**) and displays the value in Measured Results.

Obstetrical Reports

The Obstetrical patient report has the same structure for both the Early OB exam and the Standard OB exam. The report contains three tabs.

- The **Data** tab displays information from the patient data form along with labeled measurement and calculation results for all imaging modes.

- The **Standard Description** tab provides drop-down boxes with selections describing structural observations, a comments area, and a biophysical profile for the Standard OB exam.

- The **Early Description** tab provides drop-down boxes with selections describing structural observations and a comments area for the Early OB exam.

The OB report supports multiple gestational reporting and growth analysis graphs. You can generate growth analysis graphs by using data only from the current exam or by linking files to combine current data with data from previous exams. You can annotate the report and edit system-supplied data such as the LMP date. Measurements can be edited in the worksheet.

Use the system presets to select measurement and parameter labels to be included in an OB Report.

To access the patient report:

1. During an OB exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

    The system displays the first page of the **Data** tab of the report.

2. To view different pages of the report, roll the trackball to highlight **Prev** or **Next** at the bottom of the page and then press the **SET** key.

3. To redisplay the image screen, roll the trackball to **Return** at the bottom of the report and then press the **SET** key.

Multiple Gestational Reporting

When you are performing a multiple-gestation OB exam, the system maintains separate measurement and calculation results for each fetus and displays the results on separate OB report pages.

To view information for a fetus:

- During the Measurement function, roll the trackball to highlight **Fetus A**, **Fetus B**, or **Fetus C** at the top of the Measurement Menu and then press the **SET** key.

- While viewing a worksheet, a patient report, or a growth analysis graph, roll the trackball to select **A**, **B**, or **C** at the bottom of the page and then press the **SET** key.

Worksheet

In addition to the general report editing capability, the OB report has a worksheet you can use to edit measurement values, menstrual age data, and reference selections.

To access the worksheet:

1. During the Measurement function, roll the trackball to highlight **Worksheet** in the Measurement Menu and then press the **SET** key.

2. To view different pages of the worksheet, roll the trackball to highlight **Prev** or **Next** at the bottom of the page and then press the **SET** key.

3. To return to the image screen, roll the trackball to highlight **Return** at the bottom of the page and then press the **SET** key.

Editing Worksheets

Use the worksheet for editing estimated menstrual age data, estimated fetal weight data and references. When editing the worksheet, you can:

- Modify the **LMP** (or **IVF**), **Clinical MA**, and **Clinical EDC** fields. These fields can also be modified in the OB Report.

- Select a **reference** (author) other than the default for determining an estimated menstrual age for each parameter and calculation.

- Select a **reference** (author) other than the default for determining an estimated fetal weight (**EFW**).

- Select the variables to be used in the **USMA** and **EFW** calculations, if an author has more than one formula.

   Note: An **EFW** is calculated according to the ranges specified by the author of the equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

- Edit the values used for **averaging** when an averaged method is used for determining an estimated menstrual age.

   Note: Parameters or calculations are determined by either a **direct** measurement method or an **averaged** method. Use the system presets to designate a method:

   - *Direct* uses last measured value is used to estimate a menstrual age

   - *Average* calculates a simple average from as many as five measurements for each parameter or calculation.

Modify LMP, Clinical MA or Clinical EDC

When you edit either the **Clinical MA** or the **Clinical EDC**, the system determines the **LMP** and places a double asterisk (**) to the left of the **LMP** field.

To modify an LMP (or IVF), Clinical MA, or Clinical EDC:

1. Roll the trackball to position the pointer on the field for the **LMP**, **Clinical MA**, or **Clinical EDC** and then press the **SET** key.

2. Use the keyboard to enter an appropriate date.

    The system automatically updates the corresponding fields in the worksheet, the patient report, and the patient data form.

Editing this field:	Causes the system to recalculate:
LMP	Clinical MA and Clinical EDC
Clinical MA	LMP and Clinical EDC
Clinical EDC	LMP and Clinical MA

Select a Reference (Author)

An estimated fetal weight is calculated according to the ranges specified by the author of the equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

The system determines the estimated menstrual age or estimated fetal weight based on the selected author's formulas or tables.

To select a reference:

1. Roll the trackball to position the pointer on the name of the reference for the parameter or calculation label and then press the **SET** key.

2. Roll the trackball to position the pointer on the author's name and then press the **SET** key.

    The system uses the selected author's formulas or tables to recalculate an estimated age or fetal weight and updates the resulting value in the Measured Results, the worksheet, and the patient report.

Delete Measurements

To delete a measurement used for averaging:

1. Roll the trackball to the value used for averaging and then press the **SET** key.

    The system highlights the value.

2. Use the keyboard to delete the value and then press the **ENTER** key.

    The system updates the averaged value based on the remaining measurements.

Early OB Patient Report

The patient report for the Early OB exam has three tabs, each of which may have multiple pages. The report includes data from the patient data form, measured results obtained during an exam that are assigned to a label, and selected descriptive data.

Use the system presets to select measurement, parameter, and calculation labels and patient data form entries to include in the OB Report.

Descriptive Data Fields ▪ Early Description Tab

The Early Description tab of the OB patient report contains descriptive data fields. Options for each field are shown in the following table:

Descriptive Data Fields	Options	Descriptive Data Fields	Options
Viability	(Blank) **Yes** **No** **Not Applicable**	**Fetal Pole**	(Blank) **Seen** **Not Seen** **Multiple**
Uterus	(Blank) **Normal** **Anteflexed** **Retroflexed** **Fibroid(s)** **Abnormal**	**Cul-de-sac Fluid**	(Blank) **Sm Amount** **Lg Amount** **None**
Cervix	(Blank) **Normal** **Abnormal** **Incompetent**	**Adnexa**	(Blank) **Seen** **Not Seen** **Mass Rt** **Mass Lt**
Gestational Sac	(Blank) **Intrauterine** **Extrauterine** **Not Seen** **Multiple**		

Standard OB Patient Report

The patient report for the Standard OB exam includes data from the patient data form, measured results obtained during an exam that have been assigned to a label, and selected descriptive data.

Use the system presets to select specific measurement, parameter, and calculation labels and patient data form entries to include in the Standard OB Report.

Descriptive Data Fields ▪ Standard Description Tab

The Standard Description page of the Standard OB patient report contains descriptive data fields. The Biophysical Profile box at the right of this screen contains the fields shown in the following table. Next to each field is a number, between two boxes. Example: Breathing ▼ 2 ▲

Biophysical Profile	Options
Breathing	**0**, **1**, **2**
Tone	**0**, **1**, **2**
Movement	**0**, **1**, **2**
FHR	**0**, **1**, **2**
AFV	**0**, **1**, **2**

- To increase the number for a field, roll the trackball to position the pointer on the arrow to the right of the number and then press the **SET** key.

- To decrease the number for a field, roll the trackball to position the pointer on the arrow to the left of the number and then press the **SET** key.

The system displays a total of the values for all four fields.

Descriptive Data Field	Options	Descriptive Data Field	Options
Fetal Heart	(Blank) **Motion Seen** **No Motion Seen** **Not Applicable**	**Spine Lumbar**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Fetal Number	(Blank) **Singleton** **1 of 2** **2 of 2** **Multiple**	**4 CH Heart**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Fetal Position	(Blank) **Vertex** **Breech** **Transverse** **Oblique** **Variable**	**Aortic Arch**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
3-V Cord	(Blank) **Yes** **No**	**Great Vessels**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
AF Volume	(Blank) **Adequate** **Increased** **Decreased**	**4 Extremities**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Placenta Grade	(Blank) **0** **1** **2** **3**	**Diaphragm**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**

Descriptive Data Field	Options	Descriptive Data Field	Options
Placenta Location	(Blank) **Anterior** **Posterior** **Fundal** **Right** **Left**	**Abdominal Wall**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Previa	(Blank) **None** **Low-lying** **Complete**	**Stomach**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Face	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Bowel Pattern**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Spine-Neck	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Bladder**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Spine-Thoracic	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Genitalia**	(Blank) **Not Seen** **Male** **Female** **Hydrocele**

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the *Comments* field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

   A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

   The system places the phrase in the **Comments** field of the report.

   Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

   The system removes the list of phrases from the screen.

Adding Pictograms

Pictograms are graphics that indicate an anatomical structure and the orientation of the transducer to the structure. Fetal pictograms can be rotated to indicate the orientation of the fetus in utero.

To display a pictogram in a Standard OB report:

1. Repeatedly press the **PICTOGRAM** control until the appropriate pictogram displays in the report.

   The currently displayed pictogram is included in the report.

2. To remove the pictogram, repeatedly press the **PICTOGRAM** control until a pictogram does not display in the report.

To rotate the fetus in a fetal pictogram:

1. Select an in-utero fetal pictogram.

2. To rotate the position of the fetus in the pictogram, rotate the **PICTOGRAM** control.

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

▪ Press a documentation control on the control panel that is configured for the print function.

   The system transfers the information displayed on-screen to the specified documentation device.

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

▪ Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

   The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

▪ To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

Growth Analysis Graphs

A growth analysis graph displays curves or lines that indicate predicted fetal growth patterns according to the selected reference for a parameter, measurement, or calculation label. The system plots the measured results obtained for measurement, parameter, and calculation labels on the graphs.

A graph can display information acquired in the current exam only, or current information combined with data from earlier exams. Information can be graphed and displayed for up to ten exams. Use the Link Files function to combine data from multiple exams.

[2] Instructions for Use

Link	B2-35

System Reference

References	Ch 9

Labels ▪ Growth Analysis Graphs

Graph	Description	References
MSD	Mean Gestational Sac Diameter	Rempen(EV), five user-defined
CRL	Crown Rump Length	Hadlock, Robinson, Hansmann, Rempen(EV), ASUM, JSUM, Osaka, Tokyo, five user-defined
BPD	Biparietal Diameter	Hadlock, Merz, Lasser(EV), Hansmann, Rempen(EV), ASUM, Chitty (O-I), Chitty (O-O), JSUM, Osaka, Tokyo, five user-defined
OFD	Occipital Frontal Diameter	Hansmann, ASUM, Chitty, five user-defined
HC	Head Circumference	Hadlock, Merz, Hansmann, ASUM, Chitty, five user-defined
AC	Abdominal Circumference	Hadlock, Merz, Jeanty, ASUM, Chitty, JSUM, five user-defined
TAD	Transverse Abdominal Diameter	Five user-defined
FL	Femur Length	Jeanty, Hadlock, Merz, Hansmann, ASUM, JSUM, Osaka, Tokyo, five user-defined
HL	Humerus Length	Jeanty, Merz, Hansmann, ASUM, Osaka, five user-defined
UL	Ulna Length	Jeanty, Merz, Hansmann, five user-defined
TL	Tibia Length	Jeanty, Merz, Hansmann, five user-defined
FT	Foot Length	Mercer, five user-defined
TC	Thoracic Circumference	Chitkara, five user-defined
CL	Clavicle Length	Yarkoni, five user-defined

Graph	Description	References
Left RL Right RL	Renal Length, left and right	Bertagnoli, Hansmann, five user-defined
Left RAP Right RAP	Renal Dimension Anterior-Posterior, left and right	Bertagnoli, Hansmann, five user-defined
MCA RI	Middle Cerebral Artery Resistive Index	JSUM
MCA PI	Middle Cerebral Artery Pulsatility Index	JSUM
Umb A RI	Umbilical Artery Resistive Index	JSUM
Umb A PI	Umbilical Artery Pulsatility Index	JSUM
FTA	Fetal Trunk Area	Osaka
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	Tokyo
GS	Gestational Sac	Tokyo
AFI	Amniotic Fluid Index	Moore
1EFW 2EFW	Estimated Fetal Weight	Hadlock, Schuhmacher, Jeanty, Osaka, JSUM, Tokyo
HC/AC	A ratio of Head Circumference to Abdominal Circumference	Campbell
FL/AC	A ratio of Femur Length to Abdominal Circumference	Hadlock
FL/BPD	A ratio of Femur Length to Biparietal Diameter	Hohler
CI	Cephalic Index	Hadlock, Chitty
TCD/AC	A ratio of Transcerebellar Diameter to Abdominal Circumference	Meyer
User-Defined #1-5	A user-defined 2D-mode parameter label	User-defined

To view a Growth Analysis Graph:

1. Access the growth analysis graph using one of the two following methods:

   – During the Measurement function in an Obstetrical exam, roll the trackball to highlight **Graph** in the Measurement Menu and then press the **SET** key.

   – While viewing the worksheet or the patient report, roll the trackball to highlight **Graph** at the bottom of the page and then press the **SET** key.

   The system displays a graph.

2. To view another graph, roll the trackball to position the pointer on the arrow next to the drop-down list of measurement labels and then press the **SET** key.

   The system displays the list of measurement labels.

3. Roll the trackball to highlight the measurement you want to graph and then press the **SET** key.

   The system displays a dot representing the value in the patient report for that measurement. The dot is plotted against measurement values in the vertical axis and clinical MA in the horizontal axis.

4. To change the reference author, roll the trackball to position the pointer on the arrow next to the drop-down list of references and then press the **SET** key.

   The system displays the list of growth analysis references (authors) for the selected measurement.

5. Roll the trackball and use the scroll bar as necessary to highlight the reference you want to use for the measurement and then press the **SET** key.

   The system displays a line representing the mean values for that measurement over time, and lines representing one standard deviation.

6. To bring the dot representing the measurement value into line with the growth analysis graph, adjust the LMP date.

Linking Patient Data Files

The **Link Files** feature combines stored patient information from previous OB exams with current data to produce growth analysis graphs.

All exams used in growth analysis should be stored on the same disk, using an *identical Patient ID*. Use the system presets to automatically save the OB patient report data for the current exam.

When a link is requested, the system compares the Patient ID for the current exam to the Patient ID for each report stored on disk. Any or all of the displayed files can be selected for linking.

File linking causes the system to compare the value obtained for a measurement in the current exam to earlier results stored on disk for the same measurement. Measurement data for the current exam must be stored to disk before it can be used in the link.

Request Linking

▪ To link files, roll the trackball to highlight the **Link Files** button at the bottom of the page in the worksheet, the patient report, or a growth analysis graph.

   The system displays the **Link Files** screen.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ Measurements and
   Report Preset
▶▶ Customize Growth
   Analysis Graphs
▶▶▶ AutoStore
   Report Data

Selecting Files for Linking

To select files for linking:

1. Display the **Link Files** screen.

2. To include all displayed files in the link, roll the trackball to position the pointer on the **Select All** button and then press the **SET** key.

3. To include selected files in the link, roll the trackball to position the pointer on the checkbox adjacent to the patient name and then press the **SET** key. Repeat for each file to be linked.

   The system displays a check ✓ mark next to each selected file.

4. To remove a selected file from the link, roll the trackball to the checkbox and then press the **SET** key.

   The system removes the check ✓ mark.

5. To link to files on another disk, roll the trackball to the **Disk Label** field and select the disk or drive.

6. To search for additional patient files, enter the patient name in the **Patient/File Search** box, roll the trackball to the **Search** button, and then press the **SET** key.

7. When you have all the files selected, roll the trackball to highlight the **Link** option and then press the **SET** key.

   The system links measurement information from each selected file after comparing the LMP dates for all of the files. The LMP date must be the same for each exam. If the LMP is different between exams or is missing from a file, the system displays an input screen where you can specify an LMP date.

   Entering or changing the LMP date on the screen only affects the file link process, and does not change the information in the worksheet or the patient report, or stored on disk. This allows the LMP date to be adjusted to include data in the graphs, without changing the exam records.

To view linked file data in growth graphs:

1. Access the growth analysis graph and select a growth parameter and author from the drop-down lists.

2. To view measurement data from previous, linked exam reports, roll the trackball to highlight the **Previous** check box at the bottom of the screen and then press the **SET** key.

B3 Axius OB Calipers

About the Axius OB Calipers

This is an optional feature.

Axius™ Automatic OB Calipers uses specific measurement methods to automatically derive several obstetrical parameters for the head, abdomen, and femur.

You can use Axius OB to measure:

- Frozen 2D images
- 2D images recalled from the hard disk, or retrieved from a CD by using DIMAQ-IP

Axius OB measurements are not available during CINE or VCR playback.

Measurement Methods

The measurement methods display on the Measurement menu and also as LCD selections.

- Auto HC
- Auto AC
- Auto FL

Obstetrical Parameters

- Head Circumference (HC)
- Biparietal Diameter (BPD)
- Occipital-Frontal Diameter (OFD)
- Abdominal Circumference (AC)
- Abdominal-Sagittal Diameter (ASD)
- Abdominal-Transverse Diameter (ATD)
- Femur Length (FL)

Enabling the Axius OB Calipers

Use the system presets to enable and customize the Axius OB measurements.

- Enable automatic measurements of obstetrical parameters for the head, abdomen, and femur.

- Calculate the head circumference from the positions of calipers at the **OFD** (occipital-frontal diameter) endpoints or the **BPD** (biparietal diameter) endpoints and the endpoints of a perpendicular axis.

- Select the measurement method for the abdominal circumference parameter.

A brief overview of the setup selections is provided in this section.

Axius OB Preset	Description
Enable Auto Head	Activate the automatic head circumference (**Auto HC**) measurement when you select **HC** in the Measurement menu.
	The system activates the Ellipse measurement method when this preset is not selected or when **Manual HC** is selected from the LCD.
Caliper Placement Preference	Select **Near OFD end points** to measure the occipital-frontal diameter, or select **Near BPD end points** to measure the biparietal diameter.
Enable Auto Abdomen	Activate the automatic abdominal circumference (**Auto AC**) measurement when you select **AC** in the Measurement menu.
	The system activates the Ellipse measurement method when this preset is not selected or when **Manual AC** is selected from the LCD.
Measurement Method	Select the Ellipse or Cross measurement method for the automatic abdominal circumference.
Enable Auto FL	Activate the Axius OB Caliper automatic femur length measurement when you select **FL** in the Measurement menu.
	The system activates the Distance measurement method when this preset is not selected or when **Manual FL** is selected from the LCD.

Displaying Measured Results for Axes

Use the OB system presets to indicate which values to include in the patient report.

OB Preset	Description
HC with BPD/OFD measurement	Transfer labeled measured results for the two axes to the worksheet and the patient report. If not selected, the system performs the ellipse measurement without labeling the axes.
AC with ATD/ASD measurement	Transfer labeled measured results for the two axes to the worksheet and the patient report. If not selected, the system performs the ellipse or cross measurement without labeling the axes.

Measuring an Automatic Head Circumference (Auto HC)

The system can derive an automatic head circumference (**HC**) from your placement of measurement markers (calipers) on either the **OFD** (occipital-frontal diameter) or **BPD** (biparietal diameter). You can adjust the axes manually; the system updates measured results for the axes and circumference as adjustments are made.

To automatically determine an HC using OFD endpoints:

Note: Ensure that **Enable Auto Head** is enabled in the Axius OB system presets with the **Near OFD Endpoints** option selected. The system labels the measured results for the two ellipse axes if **HC with BPD/OFD** is selected in the OB system presets.

1. Activate the measurement function.

2. Select **HC** in the Measurement Menu and then press the **SET** key.

    The system activates the **Auto HC** measurement method and displays a bracket-shaped measurement marker ([]) on the image screen.

3. Roll the trackball to position the first measurement marker at one edge of the occipital-frontal diameter and then press the **SET** key on the control panel.

    The system anchors the first marker and displays a second marker.

4. Roll the trackball to position the second marker at the opposite edge of the occipital-frontal diameter (creating a line on the image of the fetal head, across the middle) and then press the **SET** key.

    The system automatically draws the perpendicular axis and the circumference.

5. Manually adjust the axes, if required.

    a. Roll the trackball to adjust the first measurement marker of the occipital-frontal diameter. Rotate the **SELECT** control to activate the second marker of the caliper set and then roll the trackball to adjust it. Press the **SET** key to complete adjustment of the occipital-frontal diameter.

       The system activates the first measurement marker of the perpendicular axis.

    b. To adjust the perpendicular axis, roll the trackball to adjust the first measurement marker and then press the **SET** key to anchor the marker. Roll the trackball to adjust the second measurement marker and then press the **SET** key to complete the measurement.

    c. To edit a completed measurement, press the **SELECT** control. Press the **SET** key as required to activate the measurement markers and roll the trackball to adjust them. Press the **SELECT** control to complete the measurement edit.

The system displays a labeled measured result for the **HC** measurement. If **HC with BPD/OFD** is selected in the OB system presets, the system assigns the **BPD** label to the measured result for the short axis and the **OFD** label to the measured result for the long axis. An age estimate displays for each labeled measurement. The system transfers the labeled measured results to the worksheet and the patient report.

To automatically determine an HC using BPD endpoints:

Note: Ensure that **Enable Auto Head** is enabled in the Axius OB system presets with the **Near BPD Endpoints** option selected. The system labels the measured results for the two ellipse axes if **HC with BPD/OFD** is selected in the OB system presets.

1. Activate the measurement function.

2. Select **HC** in the Measurement Menu and then press the **SET** key.

    The system activates the **Auto HC** measurement method and displays a bracket-shaped measurement marker ([]) on the image screen.

3. Roll the trackball to position the first measurement marker at one edge of the biparietal diameter and then press the **SET** key on the control panel.

    The system anchors the first marker and displays a second marker.

4. Roll the trackball to position the second marker at the opposite edge of the biparietal diameter (creating a line on the image of the fetal head, across the middle) and then press the **SET** key.

    The system automatically draws the perpendicular axis and the circumference.

5. Manually adjust the axes, if required.

    a. Roll the trackball to adjust the first measurement marker of the biparietal diameter. Rotate the **SELECT** control to activate the second marker of the caliper set and then roll the trackball to adjust it. Press the **SET** key to complete adjustment of the biparietal diameter.

        The system activates the first measurement marker of the perpendicular axis.

    b. To adjust the perpendicular axis, roll the trackball to adjust the first measurement marker and then press the **SET** key to anchor the marker. Roll the trackball to adjust the second measurement marker and then press the **SET** key to complete the measurement.

    c. To edit a completed measurement, press the **SELECT** control. Press the **SET** key as required to activate the measurement markers and roll the trackball to adjust them. Press the **SELECT** control to complete the measurement edit.

    The system displays a labeled measured result for the **HC** measurement. If **HC with BPD/OFD** is selected in the OB system presets, the system assigns the **BPD** label to the measured result for the short axis and the **OFD** label to the measured result for the long axis. An age estimate displays for each labeled measurement. The system transfers the labeled measured results to the worksheet and the patient report.

Measuring an Automatic Abdominal Circumference (Auto AC)

The system can derive an automatic abdominal circumference (**AC**) using either the **Ellipse** or **Cross** method selected in the Axius OB system presets. The system determines an **ASD** (Abdominal-Sagittal Diameter) and **ATD** (Abdominal-Transverse Diameter) from the axes of these measurement methods. You can adjust the axes manually; the system updates measured results for the axes and circumference as adjustments are made.

To automatically determine an AC using the Cross method:

Note: Ensure that **Enable Auto Abdomen** is enabled in the Axius OB system presets with the **Ellipse** or **Cross** option selected. The system labels the measured results for the two ellipse axes if **AC with ATD/ASD** is selected in the OB system presets.

1. Activate the measurement function.

2. Select **AC** in the Measurement Menu and then press the **SET** key.

    The system activates the **Auto AC** measurement method and displays a bracket-shaped measurement marker ([]) on the image screen.

3. Roll the trackball to position the first measurement marker at one edge of the abdominal wall and then press the **SET** key on the control panel.

    The system anchors the first marker and displays a second marker.

4. Roll the trackball to position the second marker at the opposite edge of the abdominal wall (creating a line on the image of the fetal abdomen, across the middle) and then press the **SET** key.

    The system automatically draws the perpendicular axis and the circumference.

5. Manually adjust the axis, if required.

   a. Roll the trackball to adjust the first measurement marker of the abdominal-transverse diameter. Rotate the **SELECT** control to activate the second marker of the caliper set and then roll the trackball to adjust it. Press the **SET** key to complete adjustment of the abdominal-transverse diameter.

      The system activates the first measurement marker of the perpendicular axis.

   b. To adjust the perpendicular axis, roll the trackball to adjust the first measurement marker and then press the **SET** key to anchor the marker. Roll the trackball to adjust the second measurement marker and then press the **SET** key to complete the measurement.

   c. To edit a completed measurement, press the **SELECT** control. Press the **SET** key as required to activate the measurement markers and roll the trackball to adjust them. Press the **SELECT** control to complete the measurement edit.

The system displays a labeled measured result for the **AC** measurement. If **AC with ATD/ASD** is selected in the OB system presets, the system assigns the **ASD** label to the measured result for the short axis and the **ATD** label to the measured result for the long axis. An age estimate displays for each labeled measurement. The system transfers the labeled measured results to the worksheet and the patient report.

To automatically determine an AC using the Ellipse method:

Note: Ensure that **Enable Auto Abdomen** is enabled in the Axius OB system presets with the **Ellipse** or **Cross** option selected. The system labels the measured results for the two ellipse axes if **AC with ATD/ASD** is selected in the OB system presets.

1. Activate the measurement function.

2. Select **AC** in the Measurement Menu and then press the **SET** key.

   The system activates the **Auto AC** measurement method and displays a bracket-shaped measurement marker ([]) on the image screen.

3. Roll the trackball to position the first measurement marker at one edge of the abdominal wall and then press the **SET** key on the control panel.

   The system anchors the first marker and displays a second marker.

4. Roll the trackball to position the second marker at the opposite edge of the abdominal wall (creating a line on the image of the fetal abdomen, across the middle) and then press the **SET** key.

   The system automatically draws the circumference.

5. Manually adjust the axis, if required.

    a. Roll the trackball to adjust the first measurement marker of the abdominal-transverse diameter. Rotate the **SELECT** control to activate the second marker of the caliper set and then roll the trackball to adjust it. Press the **SET** key to complete adjustment of the abdominal-transverse diameter.

    The system draws the perpendicular axis and activates a measurement marker.

    b. Roll the trackball to adjust the length of the perpendicular axis and then press the **SET** key.

    The system highlights the completed ellipse.

    c. Roll the trackball to reposition the ellipse and then press the **SET** key to complete the measurement.

    d. To edit a completed measurement, press the **SELECT** control. Press the **SET** key as required to activate the measurement markers and roll the trackball to adjust them. Press the **SELECT** control to complete the measurement edit.

The system displays a labeled measured result for the **AC** measurement. If **AC with ATD/ASD** is selected in the OB system presets, the system assigns the **ASD** label to the measured result for the short axis and the **ATD** label to the measured result for the long axis. An age estimate displays for each labeled measurement. The system transfers the labeled measured results to the worksheet and the patient report.

Measuring an Automatic Femur Length (Auto FL)

The system can derive an automatic femur length (**FL**) using the position of a measurement marker on the midpoint of the femur to determine the end points of the bone.

To automatically determine an FL:

Note: Ensure that **Enable Auto FL** is enabled in the Axius OB system presets.

1. Activate the measurement function.

2. Select **FL** in the Measurement Menu and then press the **SET** key.

    The system activates the **Auto FL** measurement method and displays a bracket-shaped measurement marker ([]) on the image screen.

3. Roll the trackball to position the first measurement marker near the midpoint of the femur and then press the **SET** key on the control panel.

    The system automatically positions two calipers at the end points of the femur.

4. Manually adjust the measurement, if required.

    a. Roll the trackball to adjust the first measurement marker. Rotate the **SELECT** control to activate the second marker of the caliper set and then roll the trackball to adjust it. Press the **SET** key to complete the measurement.

    b. To edit a completed measurement, press the **SELECT** control. Press the **SET** key as required to activate the measurement markers and roll the trackball to adjust them. Press the **SELECT** control to complete the measurement edit.

    The system displays a labeled measured result and an age estimate for the **FL** measurement. The system transfers the labeled measured result to the worksheet and the patient report.

Manual Measurements

You can change from Axius caliper measurements to manual measurements at any time. The LCD has methods for manual measurements listed with the automatic Axius measurement methods.

B4 Urology Measurements and Calculations

Urology Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Urology exam. The exam has specific 2D-mode labels and a patient report.

Measurement Menu

During a Urology exam, activating the measurement function causes the system to display a Measurement Menu on the left side of the image screen. The Measurement Menu contains system-defined measurement and calculation labels.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement and then assign the measured value to a label – *Measure then Label* – or select a label and then use the default measurement method for the selected label to perform the measurement – *Label then Measure*.

To view the measured results in the patient report, press the **F2** key on the keyboard or select **Report** in the Measurement Menu during the measurement function.

To measure then label:

Note: Use the system presets to customize the system to display a measurement marker in the image when you activate the measurement function.

1. Complete the measurement by pressing the **SET** key.

2. Roll the trackball to highlight a label in the Measurement Menu and then press the **SET** key.

    The system assigns measured results to the selected label.

To label then measure:

Note: Use the system presets to customize the system to highlight the Measurement Menu when you activate the measurement function.

1. Roll the trackball to highlight the desired label in the Measurement Menu and then press the **SET** key.

    The system activates the default measurement method for the selected label and displays it at the top of the Measurement Menu.

2. Complete the measurement using the default measurement method.

    The system assigns the measured results to the selected label.

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M&R
▶ Caliper Default
   Position

Urology ▪ 2D-Mode Measurement Labels

The system-defined measurement labels display in the Measured Results when the Urology exam is selected and in the Urology patient report with the measured result, when assigned.

Measurement Label	Description	Measurement Method Options
U.Blad	Urinary bladder	n/a
Pre V	Pre-void Volume	2PI LxDxW Volume
Post V	Post-void Volume	2PI LxDxW Volume
(Mic V)	Micturated Volume	(calculated)
Prostate-V1	Prostate Volume	2PI LxDxW Volume
Length		Distance
Depth		Distance
Width		Distance
Prostate-V2	Prostate Volume	2PI LxDxW Volume
Length		Distance
Depth		Distance
Width		Distance

Urology ▪ 2D-Mode Calculation Label

The 2D-mode calculation label for use with the Urology exam, PSAD, does not display in the Measurement Menu. Instead, the system automatically performs a calculation if you enter a PSA value in the Urology patient report and complete a volume measurement of the prostate.

Calculation Label	Description	Required Measurements
PSAD	Prostate Specific Antigen Density — Index determined by the PSA value divided by the prostate volume calculation.	A Volume (V) measurement of the Prostate and the PSA value entered using the keyboard in the Urology patient report.

Urology Patient Report

The Urology exam has a one-page patient report. The report includes data from the patient data form, measured values obtained during the exam that have been assigned to a label, and descriptive data and text entered by the user.

You can use the Report Drawing function to indicate a specific structure of interest in the patient report.

To access the Urology report:

1. During a Urology exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

    The system displays the Urology patient report.

2. To redisplay the image screen, press the **ESC** key or roll the trackball to **Return** at the bottom of the report and then press the **SET** key.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.

2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.

2. Use the keyboard to enter data.

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the *Comments* field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

    A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

    The system places the phrase in the **Comments** field of the report.

    Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

    The system removes the list of phrases from the screen.

Urology Report ▪ Descriptive Data

The Urology patient report contains drop-down boxes with descriptive data for the following information:

- Digital Rectal Exam (DRE) Malignancy Suspicion
- Trans Rectal Ultrasound System (TRUS) Prostate
- Trans Rectal Ultrasound System Seminal Vesicles

Selections are shown below.

Report Item	Selections
DRE Malignancy Suspicion	**No** **Yes** **Right** **Left** **No/-Base** **Yes/-Base** **Right/-Base** **Left/-Base** **No/-Apex** **Yes/-Apex** **Right/-Apex** **Left/-Apex** **No/-Mid** **Yes/-Mid** **Right/-Mid** **Left/-Mid**
TRUS Prostate Echogenicity	(Blank) **Normal** **Hyperechoic** **Isoechoic** **Hypoechoic** **Diffuse**
TRUS Prostate Margin	(Blank) **Intact** **Disrupted** **Intact/-Right** **Disrupted/-Right** **Intact/-Left** **Disrupted/-Left** **Intact/-Apex** **Disrupted/-Apex** **Intact/-Mid** **Disrupted/-Mid** **Intact/-Base** **Disrupted/-Base**

Report Item	Selections
TRUS Prostate Size	(Blank) **Normal** **Enlarged** **Atrophic** **Hypertrophic**
TRUS Prostate Symmetry	(Blank) **Yes** **No** **L>R** **R>L**
TRUS Seminal Vesicle Symmetry	(Blank) **Yes** **No** **L>R** **R>L**
TRUS Seminal Vesicle Size	(Blank) **Normal** **Enlarged** **Atrophic** **Hypertrophic**

Prostate References

Prostate Volume

Rifkin, Matthew D., M.D. "Prostate and Seminal Vesicle Measurements."
Chapter 16 in *Atlas of Ultrasound Measurements*. B. B. Goldburg and
A. B. Kurtz. Chicago: Year Book Medical Publishers. 1990.

Prostate Specific Antigen Density

Benson, M. C., et al. "The Use of Prostate Specific Antigen Density to
Enhance the Predictive Value of Intermediate Levels of Serum Prostate
Specific Antigen." *Journal of Urology*, 147: 817, 1992.

Report Drawing Function

Use the Report Drawing function to indicate structures of interest on the pictograms in the Urology patient report.

To indicate a structure of interest in the displayed urology report:

1. Roll the trackball to the **Draw** button on the report and then press the **SET** key on the control panel.

    A square cursor displays in the middle of the pictogram on the report.

2. Roll the trackball to place the cursor where you want to begin tracing and then press the **SET** key.

3. Roll the trackball to create a trace. Undo the trace prior to completion by pressing the **SELECT** control on the control panel. Each press of this control deletes the next most-recent dot. Resume tracing by rolling the trackball at any time. If necessary, press the **ESC** key on the control panel to delete the entire trace prior to completion.

4. When you have completed the drawing, press the **SET** key.

    The system joins beginning and ending cursor positions and marks the area created by the trace.

5. Repeat steps 1 through 4 for each structure of interest.

To remove a trace drawing from the displayed report:

1. Roll the trackball to the **Delete** button and then press the **SET** key.

    The system displays a marker in the middle of the pictogram.

2. Roll the trackball to position the marker on the trace drawing and then press the **SET** key.

    The system deletes the trace drawing.

3. Repeat steps 1 and 2 as required for each trace drawing.

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

- Press a documentation control on the control panel that is configured for the print function.

   The system transfers the information displayed on-screen to the specified documentation device.

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

- Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

   The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

- To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

B5 Vascular Measurements and Calculations

Vascular Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for the three Vascular exam types:

- Cerebrovascular Imaging
- Peripheral Vascular Imaging
- Venous Imaging

In addition to the general measurements and calculations, the Vascular exam types have measurement methods for use in 2D-mode. The Cerebrovascular exam has measurement labels in 2D-mode and Doppler. The Peripheral Vascular exam has measurement labels in Doppler. All three Vascular exams produce a patient report.

[2] Instructions for Use

General
  Measurements   Ch B1

Customizing Vascular Measurements and Reports

Use the system presets to customize a Vascular exam.

- Specify the shape, size, and default position for the caliper

- Specify whether the background for the Measured Results section of the screen has a different color than the image background

- Select the default measurement method for each mode

- Select the default method for each type of measurement

- Select the measurement methods that display on the LCD for each mode and the order in which they display

- Customize display and report options and enable operator and referring physician information for the patient report

- Define the Comments Library for the patient report

Use the system presets to further customize the Peripheral Vascular and Cerebrovascular exams.

- Select the measurement methods that display on the LCD for each mode and the order in which they display

- Establish up to two labels for use with the Measurement function in B-mode or in Doppler when the Cerebrovascular exam is active. Measured values can be assigned to the label. The label can also be used in creating user-defined formulas.

- Establish up to two labels for use with the Measurement function in Doppler when the Peripheral Vascular exam is active. Measured values can be assigned to the label. The label can also be used in creating user-defined formulas.

- Create or delete up to four ratios or formulas using established parameters. Formula labels display in the patient report. When the required measurements are performed, the calculated result also displays in the report.

System Reference

System Presets   Ch 3

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F4

M&R
▶ C-Vas, P-Vas, Venous
▶ ▶ Measurement and
      Report Presets

Indicating a Left or Right Study

When a Peripheral Vascular, Cerebrovascular, or Venous exam type is selected, you must indicate which side of the body is being imaged. When the measurement function is active, the system then transfers your measured values into the left study or the right study on the patient report.

To indicate the side of the body you are imaging:

1. During a **C-Vas**, **P-Vas**, or **Venous** exam, activate the measurement function.

2. If necessary, press the **CALIPER** key to highlight the Measurement Menu.

    The system displays the Measurement Menu with **Left** or **Right** selected.

3. To toggle the **Left** or **Right** selection on the Measurement Menu, roll the trackball to highlight the **Left** or **Right** label and then press the **SET** key.

Measurement Menu

During a Cerebrovascularor Peripheral Vascular exam, activating the measurement function causes the system to display a Measurement Menu on the left side of the image screen. The Measurement Menu indicates the selected measurement and contains system- and any user-defined labels for the active exam type and imaging mode.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement and then assign the measured value to a label – *Measure then Label* – or select a label and then use the default measurement method for the selected label to perform the measurement – *Label then Measure*.

Some measurements require the use of specific measurement methods. When you highlight a label in the Measurement Menu, the system displays the required measurement method at the top of the menu.

When a label has been assigned a measured result, the system displays the value next to the label in the Measured Results section of the screen. To view the labeled values in an exam with a patient report, press **F2** on the keyboard or select **Report** in the Measurement Menu during the measurement function.

To measure then label:

Note: Use the system presets to customize the system to display a measurement marker in the image when you activate the measurement function.

1. Complete the measurement.

2. Roll the trackball to highlight the desired label in the Measurement Menu and then press the **SET** key.

    The system assigns a value in the Measured Results to the selected label.

System Reference

System Presets   Ch 3

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F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Display Item

Except where noted, the procedures in this chapter assume a Measure-then-Label method.

To label then measure:

Note: Use the system presets to customize the system to highlight the Measurement Menu when you activate the measurement function.

1. Roll the trackball to highlight a label in the Measurement Menu and then press the **SET** key.

    The system shows the default measurement method for the selected label at the top of the Measurement Menu.

2. Complete the measurement using the default measurement method.

    The system assigns a value in the Measured Results to the selected label.

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M&R
▶ Caliper Default
  Position

Cerebrovascular ▪ 2D-Mode Measurement Labels

In addition to the system-defined 2D-mode measurement labels, you can define up to two 2D-mode or two Doppler measurement labels for the Cerebrovascular exam. These labels display in the Measurement Menu and on the first page of the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CCA	Common Carotid Artery	**A-%Stenosis** **D-%Stenosis**
ICA1	Internal Carotid Artery, first sample	**A-%Stenosis** **D-%Stenosis**
ICA2	Internal Carotid Artery, second sample	**A-%Stenosis** **D-%Stenosis**
ICA3	Internal Carotid Artery, third sample	**A-%Stenosis** **D-%Stenosis**
ECA	External Carotid Artery	**A-%Stenosis** **D-%Stenosis**
VA	Vertebral Artery	**A-%Stenosis** **D-%Stenosis**
xxxx	A user-defined label. You can define up to two measurement labels to correspond to a measurement method. Define these labels in the system presets.	The 2D-mode measurement method assigned during setup

Cerebrovascular ▪ Doppler Measurement Labels

In addition to the system-defined Doppler measurement labels, you can define up to two Doppler or 2D-mode measurement labels for the Cerebrovascular exam. These labels display in the Measurement Menu and on the first page of the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CCA	Common Carotid Artery	**PI Auto**
RI	Common Carotid Artery Resistive Index	**RI-S/D**
Systole	Common Carotid Artery Systole	**Velocity**
Diastole	Common Carotid Artery Diastole	**Velocity**
ICA1	Internal Carotid Artery	**PI Auto**
RI	Internal Carotid Artery Resistive Index	**RI-S/D**
Systole	Internal Carotid Artery Systole	**Velocity**
Diastole	Internal Carotid Artery Diastole	**Velocity**
ICA2	Internal Carotid Artery	**PI Auto**
RI	Internal Carotid Artery Resistive Index	**RI-S/D**
Systole	Internal Carotid Artery Systole	**Velocity**
Diastole	Internal Carotid Artery Diastole	**Velocity**
ICA3	Internal Carotid Artery	**PI Auto**
RI	Internal Carotid Artery Resistive Index	**RI-S/D**
Systole	Internal Carotid Artery Systole	**Velocity**
Diastole	Internal Carotid Artery Diastole	**Velocity**
ECA	External Carotid Artery	**PI Auto**
RI	External Carotid Artery Resistive Index	**RI-S/D**
Systole	External Carotid Artery Systole	**Velocity**
Diastole	External Carotid Artery Diastole	**Velocity**
VA	Vertebral Artery	**PI Auto**
RI	Vertebral Artery Resistive Index	**RI-S/D**
Systole	Vertebral Artery Systole	**Velocity**
Diastole	Vertebral Artery Diastole	**Velocity**
xxxx	A user-defined label. You can define up to two measurement labels to correspond to a measurement method.	The Doppler measurement method assigned during setup.

Peripheral Vascular ▪ Doppler Measurement Labels

In addition to the system-defined Doppler measurement labels, you can define up to two Doppler measurement labels for the Peripheral Vascular exam. These labels display in the Measurement Menu and on the first page of the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CIA	Common Iliac Artery	**PI Auto**
RI	Common Iliac Artery Resistive Index	**RI-S/D**
Systole	Common Iliac Artery Systole	**Velocity**
EIA	External Iliac Artery	**PI Auto**
RI	External Iliac Artery Resistive Index	**RI-S/D**
Systole	External Iliac Artery Systole	**Velocity**
CFA	Common Femoral Artery	**PI Auto**
RI	Common Femoral Artery Resistive Index	**RI-S/D**
Systole	Common Femoral Artery Systole	**Velocity**
PFA	Profunda Femoris Artery	**PI Auto**
RI	Profunda Femoris Artery Resistive Index	**RI-S/D**
Systole	Profunda Femoris Artery Systole	**Velocity**
SFA1	Superior Femoral Artery	**PI Auto**
RI	Superior Femoral Artery Resistive Index	**RI-S/D**
Systole	Superior Femoral Artery Systole	**Velocity**
SFA2	Superior Femoral Artery	**PI Auto**
RI	Superior Femoral Artery Resistive Index	**RI-S/D**
Systole	Superior Femoral Artery Systole	**Velocity**
SFA3	Superior Femoral Artery	**PI Auto**
RI	Superior Femoral Artery Resistive Index	**RI-S/D**
Systole	Superior Femoral Artery Systole	**Velocity**
POP A	Popliteal Artery	**PI Auto**
RI	Popliteal Artery Resistive Index	**RI-S/D**
Systole	Popliteal Artery Systole	**Velocity**

Measurement Label	Description	Measurement Method Option
TRUNK	Popliteal Trunk	**PI Auto**
RI	Popliteal Trunk Resistive Index	**RI-S/D**
Systole	Popliteal Trunk Systole	**Velocity**
ATA	Anterior Tibial Artery	**PI Auto**
RI	Anterior Tibial Artery Resistive Index	**RI-S/D**
Systole	Anterior Tibial Artery Systole	**Velocity**
PTA	Posterior Tibial Artery	**PI Auto**
RI	Posterior Tibial Artery Resistive Index	**RI-S/D**
Systole	Posterior Tibial Artery Systole	**Velocity**
PER A	Peroneal Artery	**PI Auto**
RI	Peroneal Artery Resistive Index	**RI-S/D**
Systole	Peroneal Artery Systole	**Velocity**
DPA	Dorsalis Pedis Artery	**PI Auto**
RI	Dorsalis Pedis Artery Resistive Index	**RI-S/D**
Systole	Dorsalis Pedis Artery Systole	**Velocity**
xxxx	A user-defined label. You can define up to two measurement labels to correspond to a measurement method.	The Doppler measurement method assigned during setup.

Determining an Area Percent Stenosis

The Area Percent Stenosis calculation compares cross-sectional areas of the same vessel. The system automatically performs the calculation using the following formula after you perform two traces over the same vessel.

$$\text{Area \% Stenosis} = \left(\frac{A1 - A2}{A1} \right) \times 100 \ ,$$

where A1 = the larger area, A2 = the smaller area.

To determine an area percent stenosis:

1. During a Vascular exam, freeze the image and activate the measurement function by pressing the **CALIPER** key on the control panel.

2. Press **O%Stenosis**, and the press **OA-%Stenosis** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

    The system anchors the first marker and displays a second marker as a cursor for the tracing function.

4. Roll the trackball to create a trace of the structure of interest.

    Note: You can use the **SELECT** control on the control panel to delete the trace before completing the circumference. Rotate **SELECT** counter clockwise to delete the trace or clockwise to redraw deleted portions of the trace.

5. To complete the trace, press the **SET** key to join the first and second markers.

    The Measured Results displays the area for the first trace.

6. Unfreeze the image, and acquire and freeze a second image. Reactivate the measurement function by pressing the **CALIPER** key. If you press the **ESC** key, the system erases the measurements.

    The system automatically reselects **OA-%Stenosis** on the LCD.

7. For the second trace, repeat steps 3 through 5.

    The Measured Results display the calculated area % stenosis (**%**).

Determining a Diameter Percent Stenosis

The Diameter Percent Stenosis calculation compares diameters of the same vessel. The system automatically determines the calculation using the following formula after you obtain two diameters of the same vessel.

$$\text{Diameter \% Stenosis} = \left(\frac{D1 - D2}{D1} \right) \times 100 \, ,$$

where D1 = larger diameter, D2 = smaller diameter.

To determine a diameter percent stenosis:

1. During a Vascular exam, freeze the image and activate the measurement function by pressing the **CALIPER** key on the control panel.

2. Press **O%Stenosis** and the press **OD-%Stenosis** on the 2D-mode measurement LCD.

3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

    The system anchors the marker and displays a second marker.

4. Roll the trackball to position the second measurement marker and then press the **SET** key.

    The system anchors the marker and displays the Diameter (**D1**) in the Measured Results area.

5. Unfreeze the image and acquire and freeze a second image. Reactivate the measurement function. If you press the **ESC** key, the system erases the measurements.

    The system automatically reselects **OD-%Stenosis** on the LCD.

6. Repeat steps 3 and 4 for the second diameter (**D2**).

    The system anchors the measurement marker and displays the calculated Diameter Percent Stenosis (**%**) in the Measured Results.

Vascular Patient Reports

Each Vascular exam type has a patient report. The system transfers labeled measurements and calculations from the Measured Resultson the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate portions of the report.

Use the system presets to select calculation, measurement, and parameter labels to be included in each of the Vascular patient reports. For the Cerebrovascular and Peripheral Vascular exams, you can also indicate which user-defined labels and formulas to display in each report.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ C-Vas, P-Vas, Venous
▶ ▶ Measurement and
   Report Preset

To access a Vascular Patient Report:

1. During a Vascular exam, press **F2** on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

   The system displays the patient report.

2. If the patient report has more than one page, roll the trackball to **Prev** or **Next** at the bottom of the report and then press the **SET** key.

3. To redisplay the image screen, press the **ESC** key on the control panel or roll the trackball to **Return** at the bottom of the report and then press the **SET** key.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.

2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.

2. Use the keyboard to enter data.

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the *Comments* field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

   A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

   The system places the phrase in the **Comments** field of the report.

   Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

   The system removes the list of phrases from the screen.

System Reference

System Presets   Ch 3

📄
F4

M&R
▶ Measurement and
   Report Preset
▶ ▶ Comments Library
       for Report

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

- Press a documentation control on the control panel that is configured for the print function.

  The system transfers the information displayed on-screen to the specified documentation device.

📋

F4

System Configuration
► Peripheral
► ► RS-232
► ► USB
► Customize Keys

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

- Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

  The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

- To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

Cerebrovascular Patient Report

The Cerebrovascular exam has a one-page patient report. The report includes data from the patient data form, measured values obtained during an exam that have been assigned to a label, calculations determined by the system, and selected data fields.

The report is organized as follows:

- Information common to the patient and report is presented along the top and bottom of the screen. The top row includes the name of the exam, hospital name, and date. The second row presents the patient name, ID, age, and sex. The bottom row includes navigation buttons and the name and ID of the referring physician.

- A **Data** tab presents an editable **Indication** field, editable measured results that were labeled in 2D-mode and Doppler, specific ratios, and editable blood pressure readings.

- A **Description** tab presents user-selectable descriptive data, a pictogram that you can annotate with drawings, and a comments field.

Use the system presets to select specific measurement, parameter, and calculation labels to include in the Cerebrovascular report.

Use the keyboard for direct entry of **SYS** and **DIAS** values in the **BP** field. You can enter the right and left values using up to three characters.

System Reference

System Presets   Ch 3

▤
F4

General
▶ Hospital Name
M&R
▶ Measurement and
  Report Presets

Cerebrovascular Report ▪ Description Tab

The Cerebrovascular patient report **Description** tab contains drop-down boxes with descriptive data, a drawing area, and a comments field. Options for each pull-down menu field are shown below.

Report Item	Plaque Selections (left and right)	Stenosis Selections (left and right)
ICA **ECA** **CCA**	(Blank) **None** **Smooth** **Calcific** **Irregular** **Complex**	(Blank) **None** **Mild** **Moderate** **Severe** **Pre-Occlusive** **Occluded**

Report Item	Plaque Selections (left and right)	Direction Selections (left and right)
VA	(Blank) **None** **Smooth** **Calcific** **Irregular** **Complex**	(Blank) **Antegrade** **Retrograde** **None Seen**

Indicating Structures of Interest

The **Description** tab allows you to indicate a structure of interest with a drawing tool on a pictogram.

To indicate a structure of interest in the displayed report:

1. Roll the trackball to the **Draw** button on the report and then press the **SET** key on the control panel.

   A square cursor displays in the pictogram on the report.

2. Roll the trackball to place the cursor where you want to begin tracing and then press the **SET** key.

3. Roll the trackball to create a trace. Undo the trace prior to completion by pressing the **SELECT** control on the control panel. Each press of this control deletes the next most-recent dot. Resume tracing by rolling the trackball at any time. If necessary, press the **ESC** key on the control panel to delete the entire trace prior to completion.

4. When you have completed the drawing, press the **SET** key.

   The system joins beginning and ending cursor positions and marks the area created by the trace.

5. Repeat steps 1 through 4 for each structure of interest.

To remove a trace drawing from the displayed report:

1. Roll the trackball to the **Delete** button and then press the **SET** key.

   The system displays a marker in the middle of the pictogram area.

2. Roll the trackball to position the marker on the trace drawing and then press the **SET** key.

   The system deletes the trace drawing.

3. Repeat steps 1 and 2 for each trace drawing.

Peripheral Vascular Patient Report

The Peripheral Vascular exam has a two-page patient report. The report includes data from the patient data form, measured values obtained during an exam that have been assigned to a label, calculations determined by the system and selected descriptive data.

The report is organized as follows:

- Information common to the patient and report is presented along the top and bottom of the screen. The top row includes the name of the exam, hospital name, and date. The second row presents the patient name, id, age, and sex. The bottom row includes navigation buttons and the name and id of the referring physician.

- The first page contains an editable **Indication** field, editable blood pressure readings, and editable measured results that were labeled in Doppler.

- The second page presents user-selectable fields for defining peak systolic ratios, fields for user-defined formulas, and a Comments field.

Use the system presets to select specific measurement, parameter, and calculation labels and patient data from entries to include in the Peripheral Vascular report.

Use the keyboard for direct entry of **ABI**, **SYS**, and **DIAS** values in the **BP** field. You can enter the right and left values using up to three characters.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ Measurement Report
and Presets

Venous Patient Report

The Venous patient report contains descriptive data only. Measured values do not display in the report.

The report is organized as follows:

- Information common to the patient and report is presented along the top and bottom of the screen. The top row includes the name of the exam, hospital name, and date. The second row presents the patient name, id, age, and sex. The bottom row includes navigation buttons and the name and id of the referring physician.

- The remainder of the page contains an editable **Indication** field, descriptive data fields for left and right sides, editable blood pressure information, and a **Comments** field.

Venous Report ▪ Descriptive Data Fields

The Venous patient report contains drop-down boxes with descriptive data. Selections are shown below for the IVC section of the report.

Report Item	Doppler Selections	Description Selections
IVC	(Blank) **Phasic** **Spontaneous** **Mild Reflux** **Moderate Reflux** **Severe Reflux**	(Blank) **Patent** **Subacute** **Acute** **Chronic** **Recanalized** **Resolved Doppler**

The drop-down boxes corresponding to each label initially display as blank cells. Selections are shown below.

Labels	Description Selections for all vessels (**right and left**)	Doppler Selections for all vessels (**right and left**)
EIV **CFV** **SFV(P)** **SFV(M)** **SFV(D)** **GSV(P)** **GSV(M)** **GSV(D)** **POP V** **LSV** **PTV** **ATV** **PER V** **DPV**	(Blank) **Patent** **Subacute** **Acute** **Chronic** **Recanalized** **Resolved Doppler**	(Blank) **Phasic** **Spontaneous** **Mild Reflux** **Moderate Reflux** **Severe Reflux**

B6 Cardiac Measurements and Calculations

Cardiac Measurements and Calculations

⚠ **WARNING:** Do not use the Cardiac Measurements and Calculations package unless you are thoroughly trained in echocardiography and thoroughly familiar with the safe operation of the ultrasound system.

Imaging the heart necessitates a unique methodology for precision measurements and calculation of equations. For this reason, the Cardiac exam provides measurements and methods for 2D-mode, M-mode, and Doppler that are selected on the LCD on the ultrasound system's control panel. LCD selections vary with the selected measurement type and mode. Calculated results display in the Measured Results section of the screen and, along with labeled measurements, are transferred to the Cardiac worksheet and patient report.

Customizing Cardiac Measurements and Reports

Use the system presets to customize the Cardiac exam type.

System Reference

System Presets   Ch 3

Options for Exam Configuration Default Settings

- Select the system response when the **FREEZE** key is pressed
- Create or edit the Pictogram List
- Create or edit the Text Annotation List

Options for Measurements and Reports (M & R)

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display on the LCD for each mode, and the order in which they display
- For left-ventricle guided measurements, select a system-defined pattern of measurement labels to include all the measurements for diastole and systole, or exclude specific labels from the guided measurement
- For non-guided measurements, specify which labels display in the Measurement Menu and the order in which they display
- Customize display options such as measurement titles for each mode, the method used for data averaging, the method for determining Heart Rate, and operator and referring physician information for the patient report
- Define the Comments Library for the patient report

Activating the Measurement Function

After acquiring and freezing an image, sweep, or spectrum, activate the measurement function by pressing the **CALIPER** key.

Use the system presets to activate the measurement function when the **FREEZE** key is pressed. You can also customize the system to highlight the Measurement Menu or display a measurement marker in the image when you activate the measurement function.

The system displays a measurement marker on the image and a list of measurements in the Measurement Menu for assessing Cardiac function. Each imaging mode has a specific list of Cardiac measurement types and measurement labels.

Image Screen Layout

The exam, transducer type, and Measurement Menu display on the left side of the image screen. Measured Results display at the bottom of the screen by default; use the **SELECT-R** control on the LCD panel to reposition the Measured Results section to another location on the screen.

On-Screen Calipers

Multiple caliper sets can display on an image, sweep, or spectrum at one time, depending on the measurement. Each marker is positioned by rolling the trackball and anchored in place by pressing the **SET** key.

Averaging Measured Results

You can assign up to five values to each measurement label. The system transfers the values into the worksheet.

Use the system presets to select a method for data averaging, Direct or Average. If you select the Direct method, the last value assigned to a measurement label displays next to the measurement units in the worksheet and in the patient report.

If you select the Average method, the system performs an average of the values as each value is assigned to the label. The last measured value displays in the Measured Results; the calculated average displays next to the measurement units in the worksheet and in the patient report.

System Reference

System Presets   Ch 3

F4

Default Settings
► Automatic Freeze
   Response
M&R
► Caliper Default Position

F4

M&R
► Measurement and
   Report
► ► Display Item

Cardiac ▪ Measurement Menu

The Cardiac exam has a Measurement Menu that displays on the left side of the image screen when the measurement function is active. The menu indicates which Cardiac measurement type is currently in use for the active imaging mode, and displays measurement labels for the measurement type.

Use the system presets to customize the list of measurement labels for a non-guided measurement type, or to select a pattern of labels for a guided measurement type.

To select a Cardiac measurement type:

1. Press the **CALIPER** key on the control panel.

2. Roll the trackball to highlight the name of the measurement type and then press the **SET** key.

   The system displays a list of corresponding measurement labels in the Measurement Menu.

To access the list of Cardiac measurement types:

▪ Roll the trackball to the top of the Measurement Menu to highlight the name of the current measurement type and then press the **SET** key.

   The LCD displays measurement methods for the active mode. Each mode has one or more pages of available selections. Use the **PAGE** key below the LCD to access the pages of selections.

System Reference

System Presets   Ch 3

📄
F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Measurement Order

Mitral Valve
AV/LA
LVCubed(M)
LVTeichholz(M)
LVGibson(M)

Example list of M-mode measurement types for Cardiac.

AV/LA
 RV Diam
 AO
 ACS
 LA Diam

Report
Worksheet

Example list of 2D-mode measurement labels for the selected measurement type.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement and then assign the measured value to a label—Measure then Label—or select a label and then use the default measurement method for the selected label to perform the measurement—Label then Measure.

Some Cardiac measurements require the use of specific measurement methods. For example, the EDV and ESV volume measurements must be performed using the 1Pl Disk measurement method; a volume measurement made using a different method cannot be assigned to the EDV or ESV label. When you highlight a label in the Measurement Menu, the system displays the required measurement method at the top of the menu.

When a label has been assigned a measured result, the system displays the value next to the label in the Measured Results section of the screen. To view the labeled values in the patient report, press the **F2** key on the keyboard or select **Report** in the Measurement Menu during the measurement function.

To measure then label:

Note: Use the system presets to customize the system to display a measurement marker in the image when you activate the measurement function.

1. During a Cardiac exam, acquire and freeze the image, sweep, or spectrum.

2. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Select a measurement method from the LCD to place a measurement marker in the image.

    The system displays measurement data in the Measured Results, such as (**D**) for distance, (**C**) for circumference, and (**A**) for area. The system also displays the corresponding measurement units, such as **mm** for distance and circumference, and **cm²** for area.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system automatically updates the measurement data in the Measured Results.

6. To assign the measurement data to a label, roll the trackball to select the measurement label in the Measurement Menu and then press the **SET** key.

    The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

    Note: Measurement data displays while a measurement is in progress and remains in memory until you unfreeze the image. Labeled Measured Results display when you highlight a label in the Measurement Menu.

7. To continue measurements, repeat steps 3 – 6 as required.

    The system stores up to five measurements for each label in the worksheet. The last value assigned to the label displays in the Measured Results.

To label then measure:

Note: Use the system presets to customize the system to highlight the Measurement Menu when you activate the measurement function.

1. During a cardiac exam, acquire and freeze the image, sweep, or spectrum.

2. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

    The system displays the measurement method required for the selected label at the top of the Measurement Menu, activates that measurement method, and places a measurement marker in the image. The system also displays measurement data in the Measured Results.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key to complete the measurement.

    The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

6. To continue measurements, repeat steps 3 – 5 as required.

    The system stores up to five measurements for each label in the worksheet. The last value assigned to the label displays in the Measured Results.

System Reference

System Presets   Ch 3

▤

F4

M&R
▶ Caliper Default Position

Guided Measurements

Guided Measurements are system-defined sequences of individual measurements. A list of the necessary measurements for a guided measurement displays in the Measurement Menu. Once you have started a guided measurement sequence, you must perform the measurements in the specified order.

The Cubed, Teichholz, and Gibson measurement types for 2D-mode and M-mode left ventricular function assessment use guided measurements for systole and diastole. For each measurement type, use the system presets to select a system-defined pattern of measurement labels to include all the measurements for diastole and systole, or exclude specific labels from the guided measurement.

System Reference

System Presets   Ch 3

▤
F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Measurement Order

Cardiac ▪ 2D-Mode Measurement Labels

System-defined measurement labels for the active Cardiac measurement type display in the Measurement Menu. When a measured result is assigned to a label, the label and value display in the worksheet and the patient report.

Use the system presets to customize the list of measurement labels for a non-guided measurement type, or to select a pattern of labels for a guided measurement type.

Measurement Menu Label	Description	Measurement Method
Mitral Valve	*Mitral Valve Function*	
EPSS	E Point to Septal Separation. The distance between the anterior leaflet and the ventricular septum at early diastole.	Distance
LVOT diam	Left Ventricular Outflow Tract Diameter	Distance
MVA(trace)	Mitral Valve Area	Trace
MV diam	Mitral Valve Diameter	Distance
HR	Heart Rate	
AV/LA	*Aortic Valve/Left Atrium*	
RV diam	Right Ventricular Diameter	Distance
AO	Aorta	Distance
ACS	Aortic Cusp Separation	Distance
LA diam	Left Atrial Diameter	Distance
Aortic Valve	*Aortic Valve Function*	
LVOT diam	Left Ventricular Outflow Tract Diameter	Distance
AV Area	Aortic Valve Area	Trace
HR	Heart Rate	
PISA(MR)	*Proximal Isovelocity Surface Area (Mitral Regurgitation)*	
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Manual input
PISA(MS)	*Proximal Isovelocity Surface Area (Mitral Stenosis)*	
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Manual input
Angle	Angle	Angle

Measurement Menu Label	Description	Measurement Method
LV Dimensions	*Left Ventricular Dimensions*	
RVAWd	Right Ventricular Anterior Wall at end-diastole	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
IVSd	Interventricular Septal Dimension at end-diastole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVPWd	Left Ventricular Posterior Wall Dimension at end-diastole	Distance
IVSs	Interventricular Septal Dimension at end-systole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVPWs	Left Ventricular Posterior Wall Dimension at end-systole	Distance
LV Volume-specific	*Left Ventricular Volume*	
LVAd sax PM	Left Ventricular Area at Papillary Muscle level at end-diastole in short axis view	Trace
LVAd sax MV	Left Ventricular Area at Mitral Valve level at end-diastole in short axis view	Trace
LVLd apical	Left Ventricular Length at end-diastole in apical view	Distance
LVAs sax PM	Left Ventricular Area at Papillary Muscle level at end-systole in short axis view	Trace
LVAs sax MV	Left Ventricular Area at Mitral Valve level at end-systole in short axis view	Trace
LVLs apical	Left Ventricular Length at end-systole in apical view	Distance
LVAd apical	Left Ventricular Long Axis Area at end-diastole in apical view	Trace
LVAs apical	Left Ventricular Long Axis Area at end-systole in apical view	Trace
LV Mass-specific	*Left Ventricular Mass*	
A Sax Epi	Area short axis epicardial	Area
A Sax Endo	Area short axis endocardial	Area
a	Semi-major axis from widest minor axis radius to apex	Distance
d	Truncated semi-major axis from widest minor axis radius to mitral annulus plane	
LVL	Left Ventricular Length	Distance

Cardiac ▪ 2D-Mode Calculation Labels

The system performs 2D-mode calculations when you complete the required measurements and assigns calculation labels to the results. Calculated results display in the Measured Results section of the screen and are transferred to the Cardiac worksheet and patient report.

Calculation Label	Description	Required Measurements	Units
CI	**Cardiac Index** is the cardiac output per square meter of body surface area (BSA): CI = CO÷BSA. For height in centimeters and weight in kilograms: BSA=0.007184 x (Weight$^{0.425}$)x(Height$^{0.725}$) For height in feet/inches and weight in pounds: BSA=0.007184 x (Weight x 0.454)$^{0.425}$x(Height x 2.54)$^{0.725}$	HR and BSA (BSA is determined by height and weight of patient; entered in the patient data form) EDV ESV	n/a
CO	**Cardiac Output** is the effective volume of blood ejected from the left ventricle of the heart per unit of time: CO = [(EDV – ESV) ÷ 1000](HR).	EDV ESV HR	L/min
EDV and ESV	Left Ventricular **End-Diastolic Volume** Left Ventricular **End-Systolic Volume**	Varies with the selected Volume method.	
EF	**Ejection Fraction** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV)÷EDV].	EDV ESV	%
FS	**Fractional Shortening** is the percentage of shortening of the Left Ventricular dimension. FS = 100[(LVIDd - LVIDs) ÷ LVIDd].	LVIDd LVIDs	%
SI	**Stroke Index** is a measurement of stroke volume normalized to BSA: SI = SV÷BSA.	SV BSA	mL/m^2
SV	**Stroke Volume** is the volume of blood ejected from a ventricle during one cardiac cycle or phase of ventricular systole: SV = EDV-ESV.	EDV ESV	mL

Calculation Label	Description	Required Measurements	Units
t	***Thickness of the myocardium*** t(mm) = SQRT (A Sax Epi(cm^2) *100/3.14) – SQRT (A Sax Endo(cm2)*100/3.14)	A Sax Epi A Sax Endo	mm
b	***Short axis radius*** b(mm) = SQRT (A Sax Endo(cm^2) * 100/3.14)	A Sax Endo	mm
LV Mass-I	***LV Mass Index*** describes the proportion of left ventricular mass to the body surface area LV Mass-I(g/m^2) = LV Mass(g) / BSA(m^2)	LV Mass BSA	g/m^2
LV Mass T-E	***LV Mass T-E*** estimates left ventricular mass using a Truncated Ellipse LV Mass(g)=1.05*π*((b(cm)+t(cm))^2) * (2/3*(a(cm)+t(cm)+d(cm) – (d(cm)^3) / (3*((a(cm)+t(cm))^2))) – (b(cm)^2) * (2/3*a(cm)+d(cm)-d(cm)^3) / (3*(a(cm)^2)))	a d b t	g
LV Mass A-L	***LV Mass A-L*** estimates left ventricular volume using Area and Length LV Mass(g) = 1.05*(((5/6)* A Sax Epi(cm^2) * (LVL(cm)+t(cm))) – (5/6) * A Sax Endo(cm^2)*LVL(cm))	A Sax Epi A Sax Endo LVL	g

Cardiac ▪ 2D-Mode Measurements

When the system is in 2D-mode with the Cardiac exam selected, activating the measurement function causes the LCD to display 2D-mode–specific measurement methods.

Making a 2D-Mode Distance Measurement

The distance measurement calculates the length of a straight line between two markers.

This procedure uses the CINE playback function so that both diastolic and systolic measurements can be made from one image acquisition.

Use the system presets to customize the system to activate CINE playback when you activate the measurement function.

To label then measure a distance:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Press the **CINE** key to activate CINE playback.

3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.

4. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

5. Roll the trackball to select a measurement label in the Measurement Menu that requires the Distance method, and then press the **SET** key.

   The system displays the measurement method at the top of the Measurement Menu, activates the measurement method, and places a measurement marker in the image. The system also displays measurement data in the Measured Results.

6. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors a measurement marker and displays another measurement marker.

7. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

To measure then label distance:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Press the **CINE** key to activate CINE playback.

3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.

4. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

5. If necessary, press the **CALIPER** key or select a measurement method from the LCD to place a measurement marker in the image.

    The system displays measurement data in the Measured Results.

6. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

7. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system automatically updates the measurement data in the Measured Results.

8. To assign the measurement data to a label, roll the trackball to select the measurement label in the Measurement Menu and then press the **SET** key.

    The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

Making a 2D-Mode Trace Measurement

Use the Trace measurement method to outline a structure such as the mitral valve, the aortic valve, or the left ventricular chamber. The system measures the circumference of the structure and then calculates the area.

To make a trace measurement:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select a measurement label in the Measurement Menu that requires the Trace method, and then press the **SET** key.

    The system places a measurement marker in the image and displays measurement data for circumference (**C**) and area (**A**) in the Measured Results.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker.

5. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control on the control panel counterclockwise.

6. To complete the trace, press the **SET** key.

    The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

Making a 2D-Mode Angle Measurement

Use the angle measurement method with the Proximal Isovelocity Surface Area (PISA) Mitral Stenosis (MS) measurement type.

To make an angle measurement:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Activate the measurement function.

    The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select the **Angle** measurement label in the Measurement Menu and then press the **SET** key.

    The system places a measurement marker in the image.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker at the start of the reference line and displays a measurement marker.

5. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the reference line and displays a measurement marker.

6. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the marker at the start of the angle line and displays a measurement marker.

7. Roll the trackball to position the measurement marker and then press the **SET** key.

    The system anchors the angle line, labels the α angle and β angle, and displays the angle values in the Measured Results.

Cardiac ▪ 2D-Mode Left Ventricular Function Assessment

Analysis of the heart involves the assessment of the Left Ventricular (LV) function using 2D-mode measurements.

The system allows you to select from nine different volume formulas to calculate end-diastolic (**EDV**) and end-systolic volumes (**ESV**). The Modified Simpson, Single Plane, Bi-Plane, and Bullet formulas use distance and trace measurements. The Simpson Single Plane and Simpson Bi-Plane measurement types use the 1Pl Disk volume measurement method. The Cubed, Teichholz, and Gibson formulas use guided measurements for ventricular distances.

Volume Method	Menu Label	Description	Calculated Results
Simpson Single Plane	**Simpson SP**	Estimates Volume using the 1Pl Disk measurement at end-diastole and at end-systole for the apical two-chamber view.	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a
Simpson Bi-Plane	**Simpson BP**	Estimates Volume using the 1Pl Disk measurement at end-diastole and at end-systole for the apical four-chamber view. $EDV(mL)= \pi * LVLd(mm) / 20 * \sum(r_{2i}(mm)*r_{4i}(mm)) / 1000$ $ESV(mL)= \pi * LVLs(mm) / 20 * \sum(r_{2i}(mm)*r_{4i}(mm)) / 1000$	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a
Modified Simpson Formula	**Mod. Simpson**	Estimates Volume using the trace measurement in two different views at end-diastole and at end-systole for sax MV and for sax PM. Also requires a distance measurement of the long axis dimension in an apical four-chamber view at end-diastole and at end-systole: EDV (mL) = LVLd apical(mm)/9 * (4*LVAd sax MV(cm^2) + 2*LVAd sax PM(cm^2) + SQRT (LVAd sax MV(cm^2) * LVAd sax PM(cm^2)) /10) ESV (mL) = LVLs apical(mm)/9 * (4*LVAs sax MV(cm^2) + 2*LVAs sax PM(cm^2) + SQRT (LVAs sax MV(cm^2) * LVAs sax PM(cm^2)) /10)	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a
Single Plane Formula	**Single Plane**	Estimates Volume using the trace measurement in a single plane at end-diastole and at end-systole for apical two- or four-chamber view. Also requires a distance measurement of the long axis dimension in an apical view at end-diastole end-systole: EDV = (8÷(3π)) * (LVAd apical(cm^2))^2 / LVLd apical(mm) * 10 ESV = (8÷(3π)) * (LVAs apical(cm^2))^2 / LVLs apical(mm) * 10	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a

Volume Method	Menu Label	Description	Calculated Results
Bi-plane Formula	**Bi-Plane**	Estimates Volume using the trace measurement in two planes at end-diastole and at end-systole for apical and for sax MV.	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a
		Also requires a distance measurement of the LVIDd and the LVIDs:	
		EDV = (8÷(3π)) * LVAd apical(cm2) * LVAd sax MV(cm2) / LVIDd(mm) * 10	
		ESV = (8÷(3π)) * LVAs apical(cm2) * LVAs sax MV(cm2) / LVIDs(mm) * 10	
Bullet Formula	**Bullet**	Estimates Volume using the trace measurement in one view at end-diastole and at end-systole for sax MV. Also requires a distance measurement of the long axis dimension in an apical view at end-diastole end-systole.	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 CI n/a
		This formula assumes that the left ventricle is shaped like a bullet; the base being cylindrical and the apex cone-like:	
		EDV = (5÷6) * LVLd apical(mm) * LVAd sax MV(cm^2) / 10 ESV = (5÷6) * LVLs apical(mm) * LVAs sax MV(cm^2) / 10	
Cubed Formula	**Cubed(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement:	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 FS %
		EDV = LVIDd(mm)^3 / 1000 ESV = LVIDs(mm)^3 / 1000	
Teichholz Formula	**Teichholz(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement:	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 FS %
		EDV(mL) = 7*(LVIDd(mm) * LVIDd(mm) * LVIDd(mm) / 1000) / (2.4 + LVIDd(mm) / 10)	
		ESV(mL) = (7*LVIDs(mm) * LVIDs(mm) * LVIDs(mm) / 1000) / (2.4 + LVIDs(mm) / 10)	
Gibson Formula	**Gibson(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement:	EDV mL ESV mL SV mL CO L/min EF % SI mL/m^2 FS %
		EDV(mL)= π / 6*(0.98*LVIDd(mm) / 10 + 5.90) * LVIDd(mm) / 10 * LVIDd(mm) / 10	
		ESV(mL)= π / 6*(1.14*LVIDs(mm) / 10 + 4.18) * LVIDs(mm) / 10 * LVIDs(mm) / 10	

Determining a Left Ventricular End-Diastolic or End-Systolic Volume

When a volume measurement label is selected in the Measurement Menu, the default volume measurement method displays at the top, above the name of the measurement type. The Simpson Single Plane and Simpson Bi-Plane measurement types use the 1Pl Disk volume measurement method.

Note: Use the system presets to have the system automatically derive the heart rate (HR) from a Doppler or M-mode signal or from the ECG trace. In 2D-mode, you can manually edit the heart rate value.

To determine an EDV or ESV:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Press the **CINE** key to activate CINE playback.

3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.

4. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

5. Roll the trackball to select a volume measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the image, activates the 1Pl Disk volume measurement method, and displays the area (**A**), circumference (**C**), diameter (**D**), and volume (**V**) of the structure in the Measured Results.

6. Roll the trackball to position the measurement marker to begin the volume trace and then press the **SET** key.

   The system anchors the marker.

7. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.

8. To complete the trace, press the **SET** key.

   The system connects the beginning and end points of the trace and displays a line representing the long axis.

9. Roll the trackball to position the endpoint of the long axis and then press the **SET** key.

   The system displays the volume in the Measured Results and assigns the volume value to the measurement label.

1Pl Disk
Simpson SP
▌**EDV**
 ESV

 HR(edit)
 Report
 Worksheet

Example list of 2D-mode measurement labels for a left ventricular volume measurement type.

2D-Mode Guided Measurements

The system provides guided measurements for the Cubed, Teichholz, and Gibson measurement types for left ventricular function assessment. Use the system presets to select one of the system-defined guided measurement sequences (patterns) of measurement labels for each measurement type.

This procedure describes the complete series of measurements. The measurements can also be performed individually, as non-guided measurements.

To make a guided LV function measurement:

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Activate the measurement function.

3. Select the **LV/Cubed(2D)**, **LV/Teichholz(2D)**, or **LV/Gibson(2D)** measurement type from the list in the Measurement Menu.

   The system displays the list of systole and diastole measurement labels in the Measurement Menu.

4. Roll the trackball to highlight **Diastole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the image and displays labels for the required measurements in the Measured Results. The measurement method, **LVDist**, displays at the top of the Measurement Menu.

System Reference

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Bullet
LV/Cubed(2D)
LV/Teichholz(2D)
LV/Gibson(2D)

*Example list
of 2D-Mode
measurement types.*

LVDist
LV/Cubed(2D)
▮ **Diastole**
   RVDd
   IVSd
   LVIDd
   LVPWd
  Systole
   IVSs
   LVIDs
   LVPWs
LVET
HR

*Example list of
measurement labels for
the 2D-mode Cubed
measurement type.*

5. Perform the measurements at end-diastole as follows:

    a. Roll the trackball to position the marker on the posterior right ventricular wall and then press the **SET** key.

        The system anchors the marker and displays the next measurement marker.

    b. Set the plane to complete the measurement string.

        The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

    c. Roll the trackball to position the second marker on the anterior interventricular septum and then press the **SET** key.

        The system anchors the marker, sets the plane for the remaining measurements in diastole, and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

    d. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

        The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

    e. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

        The system anchors the marker and displays the third distance value in the Measured Results. The measurement data for the fourth distance measurement in the Measured Results updates as you roll the trackball.

    f. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

        The system anchors the marker, displays the values for **RVDd**, **IVSd**, **LVIDd**, and **LVPWd** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **EDV** in the Measured Results.

        In the Measurement Menu, the system displays checkmarks next to the completed measurements and highlights **Systole** as the next suggested measurement.

| LVDist |
| LV/Cubed(2D) |
| ✔Diastole |
| ✔ RVDd |
| ✔ IVSd |
| ✔ LVIDd |
| ✔ LVPWd |
| **Systole** |
| IVSs |
| LVIDs |
| LVPWs |
| HR |

Example list of measurement labels for the 2D-mode Cubed measurement type, after completing the diastole guided measurements.

6. To perform systolic measurements, press the **SET** key.

    The system displays a measurement marker on the image and displays four distance (**D**) measurements in the Measured Results.

7. Perform the measurements at end-systole as follows:

    a. Roll the trackball to position the marker on the anterior interventricular septum and then press the **SET** key.

        The system anchors the marker and displays the next measurement marker.

    b. Set the plane to complete the measurement string.

        The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

    c. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

        The system anchors the marker, sets the plane for the remaining measurements in systole, and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

    d. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

        The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

    e. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

        The system anchors the marker, displays the values for **IVSs**, **LVIDs**, and **LVPWs** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **ESV** in the Measured Results.

To make a non-guided LV function measurement:

Note: You can either select a measurement label and then perform the measurement, or perform the measurement and then assign the label to the measured results.

1. During a Cardiac exam, acquire and freeze a 2D-mode image.

2. Activate the measurement function.

3. Select the **LV/Cubed(2D)**, **LV/Teichholz(2D)**, or **LV/Gibson(2D)** measurement type from the list in the Measurement Menu.

   The system displays the list of systolic and diastolic measurement labels in the Measurement Menu.

4. Roll the trackball to highlight any measurement label *except* **Diastole** or **Systole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the image and displays a distance (**D**) measurement in the Measured Results. The measurement method, **Distance**, displays at the top of the Measurement Menu.

5. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

6. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the distance value in the Measured Results and assigns the distance to the selected label.

   In the Measurement Menu, the system displays a checkmark next to the completed measurement and next to the **Diastole** or **Systole** series of measurements. The system also highlights the next measurement in the series.

7. Continue making measurements, as required. When all of the required measurements are made, the system calculates the **EDV** or **ESV** and displays the value in the Measured Results.

```
Distance
LV/Cubed(2D)
 Diastole
  RVDd
  IVSd
  LVIDd
  LVPWd
 Systole
  IVSs
  LVIDs
  LVPWs
HR
```

Example list of measurement labels for the 2D-mode Cubed measurement type, performed as a non-guided measurement.

```
Distance
LV/Cubed(2D)
✔Diastole
  RVDd
  IVSd
 ✔ LVIDd
  LVPWd
 Systole
  IVSs
  LVIDs
  LVPWs
HR
```

Example list of measurement labels after the first measurement.

Cardiac ▪ M-Mode Measurement Labels

System-defined measurement labels for the active Cardiac measurement type display in the Measurement Menu. When a measured result is assigned to a label, the label and value display in the worksheet and the patient report.

Use the system presets to customize the list of measurement labels for a non-guided measurement type, or to select a pattern of labels for a guided measurement type.

System Reference

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▶ Measurement and
  Report Preset
▶ ▶ Measurement Order

Measurement Menu Label	Description	Measurement Method
AV/LA	*Aortic Valve/Left Atrium function*	
RV diam	Right Ventricular Diameter	Distance
AO	Aorta	Distance
ACS	Aortic Cusp Separation	Distance
LA diam	Left Atrial Diameter	Distance
LVET	Left Ventricular Ejection Time	Time
LVPEP	Left Ventricular Pre-ejection Period	Time
Mitral Valve	*Mitral Valve function*	
CE amp	Amplitude of the E wave	Distance
CA amp	Amplitude of the A wave	Distance
DE excurs.	Anterior excursion of the mitral leaflet at early diastole.	Slope
DE amp	Amplitude of the DE wave	Distance
EPSS	E Point to Septal Separation. The distance between the anterior leaflet and the ventricular septum at early diastole.	Distance
EF Slope	Deceleration slope of the mitral leaflet's closure at early diastole	Slope

Measurement Menu Label	Description	Measurement Method
LV Dimensions	***Left Ventricle Dimensions***	
RVDd	Right ventricular dimension at end-diastole	Distance
IVSd	Interventricular septal dimension at end-diastole	Distance
LVIDd	Left ventricular internal dimension at end-diastole	Distance
LVPWd	Left ventricular posterior wall dimension at end-diastole	Distance
IVSs	Interventricular septal dimension at end-systole	Distance
LVIDs	Left ventricular internal dimension at end-systole	Distance
LVPWs	Left ventricular posterior wall dimension at end-systole	Distance
LV Function	***Left Ventricle Function***	
LVET	Left ventricular ejection time	Time

Cardiac ▪ M-Mode Calculation Labels

The system performs M-mode calculations when you complete the required measurements. The resulting values display in the Measured Results and are automatically transferred to the patient report and the Worksheet.

Calculation Label	Description	Required Measurements	Units
CI	***Cardiac Index*** is the cardiac output per square meter of body surface area (BSA): CI = CO÷BSA. For height in centimeters and weight in kilograms: BSA=0.007184 x (Weight$^{0.425}$)x(Height$^{0.725}$) For height in feet/inches and weight in pounds: BSA=0.007184 x (Weight x 0.454)$^{0.425}$x(Height x 2.54)$^{0.725}$	BSA entry in the patient data form (determined by height and weight of patient)	n/a
CO	***Cardiac Output*** is the effective volume of blood ejected by either ventricle of the heart per unit of time: CO = [(EDV - ESV)÷1000](HR).	EDV ESV HR	L/min
EDV and **ESV**	Left Ventricular End-Systolic Volume and Left Ventricular End-Diastolic Volume estimates volume from the left ventriclular internal diameter (LVID) using the distance measurement. Cubed Volume Method: EDV = LVIDd^3 ESV = LVIDs^3 Teichholz Volume Method: EDV = 7(LVIDd^3 / 1000) / (2.4+LVIDd/10) ESV = 7(LVIDs^3 / 1000) / (2.4+LVIDs/10) Gibson Volume Method: EDV = π / 6*(0.98*LVIDd/10+5.90) * LVIDd/10*LVIDd/10 ESV = π / 6*(1.14*LVIDs/10+4.18) * LVIDs/10*LVIDs/10	LVIDd LVIDs	mL

Calculation Label	Description	Required Measurements	Units
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV)÷EDV].	EDV ESV	%
AO/LA	***Aortic Ratio*** to ***Left Atrium***	LA AO	Ratio or Index
HR	***Heart Rate***: HR = 60÷(R-R interval).	HR a cardiac cycle	bpm
SI	***Stroke Index*** is a measurement of stroke volume normalized to BSA: SI = SV÷BSA.	SV BSA	mL/m^2
SV	***Stroke Volume*** is the volume of blood ejected from a ventricle during one cardiac cycle: SV = EDV-ESV.	EDV ESV	mL

Cardiac ▪ M-Mode Measurement Methods

When the system is in M-mode with the Cardiac exam selected, activating the measurement function causes the LCD to display M-mode–specific measurement methods.

Making an M-Mode Distance Measurement

The distance measurement calculates the length of a straight line between two vertical measurement markers.

[2] Instructions for Use

Measure
  then Label   B6-7

To label then measure distance:

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

   The LCD displays M-mode–specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the image and displays measurement data in the Measured Results.

4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key to complete the measurement.

   The system displays the distance value in the Measured Results and assigns the distance to the selected label.

6. Continue measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Heart Rate Measurement

This measurement method determines the heart rate by delineating one heart cycle with measurement markers that display as vertical lines.

Note: You can modify the number of heart cycles used to determine a heart rate.

To determine a heart rate:

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select the **HR** measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the sweep and displays time (**T**) and heart rate (**HR**) values in the Measured Results.

4. To modify the number of heart cycles:

   a. Press the **SELECT** control on the control panel.

   b. Press the **SET** key on the control panel or press **OModify** on the M-mode measurement LCD.

   c. To change the number of heart cycles, rotate the **SELECT** control on the control panel.

      The system displays the number of heart cycles in the Measured Results.

   d. To reposition the measurement marker, roll the trackball and then press **SET**.

5. Roll the trackball to position the measurement marker on the sweep at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

6. Roll the trackball to position the next measurement marker at the end of the cardiac cycle and then press the **SET** key.

   The system displays the calculated heart rate in the Measured Results and transfers the value to the Worksheet and the Cardiology Report.

Making a Time Measurement

The Time method measures the change in time between two points. Time is calculated on the horizontal axis. A measurement marker displays as a vertical line.

To label then measure time:

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select the **LVET** or **LVPEP** measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the sweep and displays the time (**T**) value in the Measured Results.

4. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the time value in the Measured Results and assigns the distance to the selected label.

Making a Slope Measurement

The Slope measurement measures the change in distance over time, as determined by two distance measurement markers.

To measure then label a slope:

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Press **◯Slope** on the LCD.

   The system places a measurement marker on the sweep and displays the slope (**S**) value in the Measured Results.

4. Roll the trackball to position the measurement marker on the sweep and then press the **SET** key.

   The system anchors the marker and displays the next measurement marker.

5. Roll the trackball to position the second marker then press the **SET** key.

   The system displays the slope value in the Measured Results.

6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the measured result to the label.

Cardiac ▪ M-Mode Left Ventricular Function Assessment

The system provides guided measurements for the Cubed, Teichholz, and Gibson measurement types for left ventricular function assessment. Use the system presets to select one of the system-defined guided measurement sequences (patterns) of measurement labels for each measurement type.

These measurements can also be performed individually, as non-guided measurements.

To make a guided LV function measurement:

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

3. Select the **LV/Cubed(M)**, **LV/Teichholz(M)**, or **LV/Gibson(M)** measurement type from the list in the Measurement Menu.

   The system displays the list of systole and diastole measurement labels in the Measurement Menu.

4. Roll the trackball to highlight **Diastole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the sweep and displays four distance (**D**) measurements in the Measured Results. The measurement method, LVDist, displays at the top of the Measurement Menu.

5. Perform the measurements at end-diastole as follows:

   a. Roll the trackball to position the marker on the posterior right ventricular wall and then press the **SET** key.

      The system anchors the marker and displays the next measurement marker. The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

   b. Roll the trackball to position the second marker on the anterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

   c. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

| Mitral Valve |
| AV/LA |
| **LV/Cubed(M)** |
| LV/Teichholz(M) |
| LV/Gibson(M) |

Example list of M-mode measurement types.

| LVDist |
| LV/Cubed(M) |
| ▌**Diastole** |
| RVDd |
| IVSd |
| LVIDd |
| LVPWd |
| Systole |
| IVSs |
| LVIDs |
| LVPWs |
| LVET |
| HR |

Example list of measurement labels for the M-mode Cubed measurement type.

    d. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

       The system anchors the marker and displays the third distance value in the Measured Results. The measurement data for the fourth distance measurement in the Measured Results updates as you roll the trackball.

    e. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

       The system anchors the marker, displays the values for **RVDd**, **IVSd**, **LVIDd**, and **LVPWd** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **EDV** in the Measured Results. In the Measurement Menu, the system displays checkmarks next to the completed measurements and highlights **Systole** as the next suggested measurement.

6. To perform systolic measurements, press the **SET** key.

   The system displays a measurement marker on the sweep and displays four distance (D) measurements in the Measured Results.

LVDist
LV/Cubed(M)
✔Diastole
✔ RVDd
✔ IVSd
✔ LVIDd
✔ LVPWd
Systole
  IVSs
  LVIDs
  LVPWs
LVET
HR

Example list of measurement labels for the M-mode Cubed measurement type, after completing the diastole guided measurements.

7. Perform the measurements at end-systole as follows:

    a. Roll the trackball to position the marker on the anterior interventricular septum and then press the **SET** key.

        The system anchors the marker and displays the next measurement marker. The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

    b. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

        The system anchors the marker and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

    c. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

        The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

    d. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

        The system anchors the marker, displays the values for **IVSs**, **LVIDs**, and **LVPWs** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **ESV** in the Measured Results.

8. Roll the trackball to highlight **LVET** in the Measurement Menu and then press the **SET** key.

    The system displays a measurement marker on the sweep and displays a time (**T**) value in the Measured Results.

9. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

10. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system displays the time value in the Measured Results and assigns the distance to the **LVET** label.

To make a non-guided LV function measurement:

Note: You can either select a measurement label and then perform the measurement, or perform the measurement and then assign the label to the measured results.

1. During a Cardiac exam, acquire and freeze an M-mode sweep.

2. Activate the measurement function.

3. Select the **LV/Cubed(M)**, **LV/Teichholz(M)**, or **LV/Gibson(M)** measurement type from the list in the Measurement Menu.

    The system displays the list of systole and diastole measurement labels in the Measurement Menu.

4. Roll the trackball to highlight any measurement label *except* **Diastole** or **Systole** in the Measurement Menu and then press the **SET** key.

    The system displays a measurement marker on the sweep and displays a distance (**D**) measurement in the Measured Results. The measurement method, Distance, displays at the top of the Measurement Menu.

5. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

    The system anchors the marker and displays another measurement marker.

6. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system displays the distance value in the Measured Results and assigns the distance to the selected label.

    In the Measurement Menu, the system displays a checkmark next to the completed measurement and the set of measurements (Diastole or Systole) to which it belongs. The system also highlights the next suggested measurement.

7. Continue making measurements, as required. When all of the required measurements are made, the system calculates the **EDV** or **ESV** and displays the value in the Measured Results.

```
Distance
LV/Cubed(M)
 Diastole
  RVDd
  IVSd
  LVIDd
  LVPWd
 Systole
  IVSs
  LVIDs
  LVPWs
LVET
HR
```

Example list of measurement labels for the M-mode Cubed measurement type, performed as a non-guided measurement.

```
Distance
LV/Cubed(M)
✔Diastole
  RVDd
  IVSd
✔ LVIDd
  LVPWd
 Systole
  IVSs
  LVIDs
  LVPWs
LVET
HR
```

Example list of measurement labels after the first measurement.

Cardiac ▪ Doppler Measurement Labels

System-defined measurement labels for the active Cardiac measurement type display in the Measurement Menu. When a measured result is assigned to a label, the label and value display in the worksheet and the patient report.

Use the system presets to customize the list of measurement labels for a non-guided measurement type, or to select a pattern of labels for a guided measurement type.

Measurement Menu Label	Description	Measurement Method
Aortic Valve	*Aortic Valve Function*	
AV VTI	Aortic Valve Velocity-time Integral	PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-time Integral	PI Manual
IVRT	Isovolumic Relaxation Time	Time
AVA(VTI)	*Aortic Valve Area (Velocity-time Integral)*	
AV VTI	Aortic Valve Velocity-time Integral	PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-time Integral	PI Manual
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
AVA(Vmax)	*Aortic Valve Area*	
AV Vmax	Aortic Valve Maximum Velocity	Velocity
LVOT Vmax	Left Ventricular Outflow Tract Maximum Velocity	Velocity
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
AVA(Trace)	*Aortic Valve Area*	
AV Area	Aortic Valve Area	Trace
VSD	*Ventricular Septal Defect*	
VSD Vmax	Ventricular Septal Defect Maximum Velocity	Velocity
LVSTI	*Left Ventricular Systolic Time Interval*	
LVET	Left Ventricular Ejection Time	Time
LVPEP	Left Ventricular Pre-ejection Period	Time
HR	Heart Rate	HR

Measurement Menu Label	Description	Measurement Method
Mitral Valve	*Mitral Valve Function*	
E Dur	E-wave Duration	Time
A Dur	A-wave Duration	Time
IVRT	Isovolumic Relaxation Time	Time
MV E pt	Mitral Valve E point	Velocity
MV A pt	Mitral Valve A point	Velocity
MVA(PHT)	*Mitral Valve Area*	
PHT	Pressure Half-Time	PHT
MVA(VTI)	*Mitral Valve Area (Velocity-time Integral)*	
MV VTI	Mitral Valve Velocity-time Integral	PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-time Integral	PI Manual
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
MVA(Trace)	*Mitral Valve Area*	
MVA(Trace)	Mitral Valve Area	Trace
CO	*Cardiac Output*	
MV VTI	Mitral Valve Velocity-time Integral	PI Manual
MV diam	Mitral Valve diameter	Distance
HR	Heart Rate	HR
LVIMP	*Left Ventricular Index of Myocardial Performance*	
LVET	Left Ventricular Ejection Time	Time
MV C-Odur	Mitral Valve Close-Open duration	Time
Tricusp. Valve	*Tricuspid Valve Function*	
TV Vmean	Tricuspid Valve Velocity mean	PI Manual
TV Vmax	Tricuspid Valve Velocity maximum	Velocity
TV E pt	Tricuspid Valve E point	Velocity
TV A pt	Tricuspid Valve A point	Velocity
RVIMP	*Right Ventricular Index of Myocardial Performance*	
RVET	Right Ventricular Ejection Time	Time
TV C-Odur	Tricuspid Valve Close-Open duration	Time

Measurement Menu Label	Description	Measurement Method
Pulmo. Valve	*Pulmonary Valve Function*	
PV Vmax	Pulmonary Valve Velocity maximum	Velocity
RVET	Right Ventricular Ejection Time	Time
RV Act	Right Ventricular Acceleration Time	Time
RVPEP	Right Ventricular Pre-ejection Period	Time
CO	*Cardiac Output*	
PV VTI	Pulmonary Valve Velocity-time Integral	PI Manual
PV diam	Pulmonary Valve diameter	Distance
HR	Heart Rate	HR
Pulmo. Vein	*Pulmonary Vein Function*	
PVs1 Vel	Pulmonary Vein systole1 Velocity	Velocity
PVs2 Vel	Pulmonary Vein systole2 Velocity	Velocity
PVd Vel	Pulmonary Vein diastolic Velocity	Velocity
PVa Vel	Pulmonary Vein late diastolic Velocity	Velocity
PVa dur	Pulmonary Vein late diastolic duration	Time
PVs VTI	Pulmonary Vein systolic Velocity-time Integral	PI Manual
PVd VTI	Pulmonary Vein diastolic Velocity-time Integral	PI Manual
PVd Dect	Pulmonary Vein diastolic Deceleration Time	DcT
AR	*Aortic Regurgitation*	
Decel Time	Deceleration Time	Time
AI PHT	Aortic Insufficiency Pressure Half-Time	PHT
TR	*Tricuspid Regurgitation*	
TR Vmean	Tricuspid Regurgitation Velocity mean	PI Manual
TR Vmax	Tricuspid Regurgitation Velocity maximum	Velocity

Measurement Menu Label	Description	Measurement Method
RAP select	*Right Atrial Pressure selection*	
0mmHg	Millimeters of mercury	Manual input or selection
5mmHg	Millimeters of mercury	Manual input or selection
10mmHg	Millimeters of mercury	Manual input or selection
15mmHg	Millimeters of mercury	Manual input or selection
20mmHg	Millimeters of mercury	Manual input or selection
25mmHg	Millimeters of mercury	Manual input or selection
MR	*Mitral Regurgitation*	
MR Vmax	Mitral Regurgitation Velocity maximum	Velocity
dP/dt	Rate of change of pressure over time DP/dt=32 / dt x 1000	dP/dt
PISA(MR)	*Proximal Isovelocity Surface Area (Mitral Regurgitation)*	
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Manual input
MR VTI	Mitral Regurgitation Velocity-time Integral	PI Manual
PISA(MS)	*Proximal Isovelocity Surface Area (Mitral Stenosis)*	
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Manual input
MS VTI	Mitral Stenosis Velocity-time Integral	PI Manual
Angle	Angle	Angle

Cardiac ▪ Doppler Calculation Labels

The system performs Doppler calculations when you complete the required measurements. The resulting values display in the Measured Results and are automatically transferred to the Patient Report and the Worksheet.

Calculation Label	Description	Required Measurements	Units
A/E	Mitral Valve ratio of the A point to the E point A/E=MV A pt(m/s) / MV E pt(m/s)	MV A point (Distance) MV E point (Distance)	n/a
E/A	Mitral Valve ratio of the E point to the A point E/A=MV E pt(m/s) / MV A pt (m/s)	MV E point (Distance) MV A point (Distance)	n/a
CA/CE	Mitral Valve ratio of the CA amplitude to the CE amplitude CA/CE=CA amp (mm) / CE amp (mm)	CA amp (Distance) CE amp (Distance)	n/a
MV PG max	Mitral Valve Pressure Gradient maximum MV PGmax(mmHg)=(MV Vmax(m/s)$)^2$*4	MV Vmax	mmHg
MV PG mean	Mitral Valve Pressure Gradient mean MV PGmean(mmHg)=(MV Vmean(m/s)$)^2$*4	MV Vmean	mmHg
CO	Cardiac Output (Doppler-derived) CO(L/min)=SV(mL) / 1000*HR(bpm)	(Valve-specific) VTI (Valve-specific)diam Heart Rate	L/min
MR PG max	Mitral Regurgitation Maximum Pressure Gradient MR PGmax(mmHg)=(MR Vmax(m/s)$)^2$*4	MR Vmax	mmHg
AV PG max	Aortic Valve Maximum Pressure Gradient AV PG max(mmHg)=(AV Vmax(m/s)$)^2$*4	AV Vmax	mmHg
AV PG mean	Aortic Valve Mean Pressure Gradient AV PG mean(mmHg)=(AV Vmean(m/s)$)^2$*4	AV Vmean	mmHg
PV PG max	Pulmonary Valve Maximum Pressure Gradient PV PGmax(mmHg)=(PV Vmax(m/s)$)^2$*4	PV Vmax	mmHg
PV PG mean	Pulmonary Valve Mean Pressure Gradient PV PGmean(mmHg)=(PV Vmean(m/s)$)^2$*4	PV V mean	mmHg
TR PG max	Tricuspid Regurgitation Pressure Gradient maximum TR PGmax(mmHg)=(TR Vmax(m/s)$)^2$*4	TR Vmax	mmHg
TR PG mean	Tricuspid Regurgitation Pressure Gradient mean TR PGmean(mmHg)=(TR Vmean(m/s)$)^2$*4	TR Vmean	mmHg
RVSP	Right Ventricular Systolic Pressure is determined from the tricuspid regurgitation velocity converted to a pressure gradient: RVSP(mmHg)=(TR Vmax(m/s)$)^2$*4 + RAP(mmHg)	TR Vmax RAP	mmHg

Calculation Label	Description	Required Measurements	Units
LVOT PG max	Left Ventricular Outflow Tract Maximum Pressure Gradient LVOT PGmax(mmHg)=(LVOT Vmax(m/s))^2*4	LVOT Vmax	mmHg
LVOT PG mean	Left Ventricular Outflow Tract Mean Pressure Gradient LVOT PGmean(mmHg)=(LVOT Vmean(m/s))^2*4	LVOT Vmean	mmHg
VSD PGmax	Ventricular Septal Defect Maximum Pressure Gradient VSD PGmax(mmHg)=(VSD Vmax(m/s))^2*4	VSD Vmax	mmHg
TV PGmax	Tricuspid Valve maximum Pressure Gradient TV PGmax(mmHg)=(TV Vmax(m/s))^2*4	TV Vmax	mmHg
TV PGmean	Tricuspid Valve mean Pressure Gradient TV PGmean(mmHg)=(TV Vmean(m/s))^2*4	TV Vmean	mmHg
AR PGmax	Aortic Regurgitation maximum Pressure Gradient AR PGmax(mmHg)=(AR Vmax(m/s))^2*4	AR Vmax	mmHg
MS PGmax	Mitral Stenosis maximum Pressure Gradient MS PGmax(mmHg)=(MS Vmax(m/s))^2*4	MS Vmax	mmHg
LVIMP	Left Ventricular Index of Myocardial Performance LVIMP=(MV C-Odur(ms) - LVET(ms)) / LVET(ms)	MV C-Odur LVET	n/a
RVIMP	Right Ventricular Index of Myocardial Performance RVIMP=(TV C-Odur(ms) - RVET(ms)) / RVET(ms)	TV C-Odur RVET	n/a
HR	Heart Rate: HR = 60/R-R interval.	Measure across one heart cycle	bpm
MVA(VTI)	Mitral Valve Area (Velocity-time Integral) MVA(VTI)(cm^2) = π*(LVOT diam(mm)/2/10)^2 * (LVOT VTI(cm) / MV VTI(cm))	LVOT diam LVOT VTI MV VTI	cm^2
AVA(VTI)	Aortic Valve Area (Velocity-time Integral) AVA(VTI)(cm^2) = π*(LVOT diam(mm)/2/10)^2 * (LVOT VTI(cm) / AV VTI(cm))	LVOT diam LVOT VTI AV VTI	cm^2

Qp/Qs	Qp/Qs = CO(L/min)(Pulmonary Valve) / CO(L/min)(Aortic Valve)	CO Pulmonary Valve
		Aortic Valve:
		  LVOT VTI
		  LVOT diam
		  Heart Rate
			n/a

Qp-Qs	Qp-Qs(L/min) = CO(L/min)(Pulmonary Valve) – CO(L/min)(Aortic Valve)	CO Pulmonary Valve
		Aortic Valve:
		  LVOT VTI
		  LVOT diam
		  Heart Rate
			L/min

Cardiac ▪ Doppler Measurements and Measurement Methods

When the system is in Doppler with the Cardiac exam selected, activating the measurement function causes the LCD to display Doppler-specific measurement methods.

Making a Velocity Measurement

To measure then label velocity:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

    The LCD displays Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Press **⟲Velocity** on the LCD.

    The system places a measurement marker on the spectrum.

4. Roll the trackball to position the measurement marker on the peak velocity on the spectrum and then press the **SET** key.

    The system anchors the measurement marker and updates velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) values in the Measured Results.

5. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

    The system assigns the measured result to the label.

6. Continue making measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Time Measurement

The Time method measures intervals between two measurement markers. The markers display as vertical lines. The system calculates time on the horizontal axis.

To measure then label time:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Press **OTime** on the LCD.

   The system places a measurement marker on the spectrum.

4. Roll the trackball to position the measurement marker on the spectrum and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker on the spectrum and then press the **SET** key.

   The system anchors a measurement marker and updates time (**T**) in the Measured Results.

6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the label to the measured result.

7. Continue measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Heart Rate Measurement

The Heart Rate measurement requires one cardiac cycle. A measurement marker displays as a vertical line.

Note: You can modify the number of heart cycles used to determine a heart rate.

To measure heart rate:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select the **HR** measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the spectrum.

4. Roll the trackball to position the measurement marker on the spectrum at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the next measurement marker at the end of the cardiac cycle and then press the **SET** key.

   The system displays the calculated heart rate in the Measured Results and transfers the value to the Worksheet and the Cardiology Report.

6. To modify the number of heart cycles:

   a. Press the **SELECT** control on the control panel.

   b. Press the **SET** key on the control panel or press **OModify** on the Doppler measurement LCD.

   c. To change the number of heart cycles, rotate the **SELECT** control on the control panel.

      The system displays the number of heart cycles in the Measured Results.

   d. To reposition the measurement marker, roll the trackball and then press **SET**.

Making a Trace

Making a trace requires a manual trace of a Doppler waveform. The system determines a maximum velocity and uses the trace to calculate a mean velocity, maximum and mean pressure gradient, and a velocity-time integral.

To measure then label a trace:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods; use the **Page** key below the LCD as needed. The Measurement Menu displays measurement labels.

3. Press **OPI Manual** on the LCD.

   The system displays a measurement marker on the spectrum.

4. Roll the trackball to position the marker at the beginning of the waveform and then press the **SET** key.

   The system places another measurement marker on the spectrum and displays measurement data in the Measured Results.

5. Roll the trackball to create a trace of the waveform. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.

6. To complete the trace, press the **SET** key.

   The system displays the values in the Measured Results.

Making an Acceleration Measurement

Acceleration and deceleration times are derived by measuring the change of velocity over time, using a slope formula.

To measure then label an acceleration/deceleration:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Press **OAccel** on the LCD.

   The system places a measurement marker on the spectrum and displays values for acceleration (**Accel**), time (**T**), and velocity (**Vmx**) in the Measured Results.

4. Roll the trackball to position the measurement marker on the velocity in the waveform and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

5. Roll the trackball to position the marker at the end of the acceleration velocity and then press the **SET** key.

   The system updates the values in the Measured Results.

6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the measured results to the labels.

Determining a Pressure Gradient

The system calculates a maximum pressure gradient either from a maximum velocity, using a velocity measurement method, or from the tracing of a Doppler waveform, using the trace measurement method.

The system uses a Bernoulli equation to calculate the maximum pressure gradient:

$$P_1 - P_2 = 4V^2.$$

The mean pressure gradient is calculated from the area of the Doppler spectrum using the trace measurement method.

Measuring a VTI (Continuity Equation)

The system calculates a velocity-time integral, maximum and mean velocities, and maximum and mean pressure gradients from a trace of the Doppler spectrum.

To label then measure a velocity-time integral:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select a **VTI** label in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker, with an arrow at the spectrum baseline, and displays measurement data in the Measured Results.

4. Roll the trackball to to position the measurement marker on the spectrum and then press the **SET** key.

   The system displays another measurement marker on the spectrum. The active measurement marker is green, the anchored marker and the trace are white.

5. Roll the trackball to create a trace of the waveform. To delete (undo) a segment of the trace, rotate the **SELECT** control counterclockwise.

6. To complete the trace, press the **SET** key.

   The system displays both measurement markers and the completed trace in a single color. The system calculates and displays the values for VTI, Vmax, PGmax, Vmean, and PGmean in the Measured Results and assigns the values to the labels in the worksheet and patient report.

Determining a Valve Area by Pressure Half Time

The Area Pressure Half Time measurement method requires a peak velocity and a diastolic slope to determine a valve area by measuring the time it takes for the pressure to drop by one half.

To determine avalve area using pressure half-time:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select a **PHT** label in the Measurement Menu and then press the **SET** key.

   The system displays a value for pressure half-time (**PHT**).

4. Roll the trackball to position the measurement marker on the spectrum at the peak velocity and then press the **SET** key.

   The system displays another measurement marker on the spectrum.

5. Roll the trackball to position the second marker on the deceleration of the mitral valve and then press the **SET** key.

   The system calculates and displays the values for deceleration time, deceleration slope, pressure half-time, diameter, the calculated area, and the traced area in the Measured Results and assigns the corresponding values to the labels in the worksheet and patient report.

Measuring Mitral Valve Regurgitation

The system provides two MR measurements.

The Doppler dP/dt measurement method measures left ventricular systolic performance. It uses the mitral regurgitation (MR) jet to infer information about the left ventricle, by determining the time required for mitral regurgitation to change from 1 m/s to 3 m/s.

To measure mitral valve regurgitation velocity:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select **MR Vmax** in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the spectrum.

4. Roll the trackball to position the measurement marker on the peak velocity on the spectrum and then press the **SET** key.

   The system anchors the measurement marker and updates velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) values in the Measured Results.

To perform the dP/dt measurement:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.

2. Activate the measurement function.

   The LCD displays mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

3. Roll the trackball to select **dP/dt** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker and two horizontal lines indicating regurgitation velocities of 1 m/s and 3 m/s.

4. Roll the trackball to the point where the MR jet intersects the reference line at a velocity of 1 m/s and then press the **SET** key.

   The system displays another measurement marker on the spectrum.

5. Roll the trackball to the point where the MR jet intersects the reference line at a velocity of 3 m/s and then press the **SET** key.

   The system calculates and displays the value for dP/dt in the Measured Results and assigns the value to the label in the worksheet and patient report.

Cardiology Patient Worksheets and Reports

The system transfers the labeled measurements and calculations from each Cardiac measurement type into the Cardiology Worksheets and the Cardiology Report. Information from the Patient Data form displays in the top two lines of the patient report.

Each Cardiac measurement type has a separate worksheet. Measurements can be edited only in the worksheet, and edited values are indicated in the worksheet and report with an asterisk (*).

Using the Cardiology Worksheet

The measurements for a measurement type display in the same worksheet even if the measurements are taken in different imaging modes. For example, the AV/LA measurement type uses four distance measurements; if these measurements are made in 2D-mode, they still appear in the same worksheet as the two M-mode time measurements. An exception is the Mitral Valve measurement type, which has separate lists of measurement labels for 2D-mode and for M-mode, and therefore two worksheets.

The first four labels in the illustration below are measurements. You can edit measurements directly in the worksheet. The last three labels in the illustration are calculations. When you edit one of the measurements required for a calculation, the system updates the calculated value.

Cardiology Worksheet			**Hospital Name** Date: / / /					
Patient Name Patient ID								
BP(SYS/DIA): mmHg Height: cm Weight: kg BSA: m^2								
PISA(MR)								
			1st	2nd	3rd	4th	5th	
Radius	xy.z	mm	xx.y	xy.x	xy.z			
Aliasing Vel	*ab.c	m/s	*ab.c					
MR VTI		cm						
MR Vmax		m/s						
Flow Rate		mL/s						
EO Area		cm^2						
Flow Vol		mL						
				Delete All | Delete Line | Delete Cell				
Page 1/2 Prev Next				Send Report		Report	Return	

To access a Cardiology Worksheet:

1. During a Cardiac exam, roll the trackball to highlight **Worksheet** in the Measurement Menu during the measurement function.

   The system displays the Cardiology Worksheet.

2. To view a different page of the worksheet, roll the trackball to position the pointer on **Prev** or **Next** at the bottom of the page and then press the **SET** key.

3. To return to the image, roll the trackball to position the pointer on **Return** at the bottom of the page and then press the **SET** key.

To move from the worksheet to the patient report:

1. Display the Cardiology Worksheet.

2. Roll the trackball to position the pointer on **Report** at the bottom of the report screen, and then press the **SET** key.

   The system displays the first page of the Cardiology Report.

3. To access a different report page, roll the trackball to position the pointer on **Prev** or **Next** at the bottom of the report and then press the **SET** key.

To move from the patient report to the worksheet:

1. Display the Cardiology Report. Each column of the Cardiology Report represents one worksheet; use **Prev** and **Next** as needed to display the appropriate page of the report.

2. Roll the trackball to position the pointer on the button next to the name of the measurement type, and then press the **SET** key.

   The system highlights the button for the selected measurement type.

3. Roll the trackball to position the pointer on **Worksheet** at the bottom-right of the report screen, and then press the **SET** key.

   The system displays the worksheet for the selected measurement type.

Editing Worksheets

Edit a worksheet to change the values that display in the patient report and the Measured Results. To change calculated results, edit the measurements that are components of the calculation.

The system displays an asterisk (*) next to an edited value. If an edited value is used in data averaging, an asterisk displays next to the calculated average.

To edit a value in the worksheet:

1. Display the worksheet.

2. Roll the trackball to position the pointer in the cell that you want to edit and then press the **SET** key.

    The system shifts the value in the cell to the left.

3. Use the keyboard to edit the value.

4. Roll the trackball to position the pointer outside of the cell and then press the **SET** key.

    The system displays an asterisk next to the value. If data averaging is used, the system also displays an asterisk next to the new average value.

    Note: If the value just edited is used in a calculation, the system displays an asterisk next to the newly-calculated value.

To delete one value for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.

2. Roll the trackball to highlight **Delete Cell** at the bottom-right of the worksheet and then press the **SET** key.

    The system clears the selected cell in the worksheet. If data averaging is used, the system updates the averaged value based on the remaining measurements.

F4

M&R
▶ Measurement and
  Report Preset
▶ ▶ Display Item

To delete all values for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.

2. Roll the trackball to highlight **Delete Line** at the bottom-right of the worksheet and then press the **SET** key.

    The system displays a verification message.

3. Roll the trackball to **OK** and then press the **SET** key.

    The system removes all values for that measurement from the Worksheet.

    Note: If the value just deleted is used in a calculation, the system removes the calculated value from the worksheet and the Measured Results.

To delete all values for a measurement type:

1. Roll the trackball to highlight **Delete All** at the bottom-right of the worksheet and then press the **SET** key.

    The system displays a verification message.

2. Roll the trackball to position the pointer on **OK** and then press the **SET** key.

    The system removes all values for all measurements from the worksheet, and clears the column in the report for that measurement type. If you do not make any more measurements for that measurement type, the system removes the column from the patient report.

Using the Cardiology Report

The measurements for a measurement type display in the same report column even if the measurements are taken in different imaging modes. An exception is the Mitral Valve measurement type, which has separate lists of measurement labels for 2D/Doppler and for M-mode, and therefore two columns in the patient report.

In the illustration below, the patient report contains values for two measurement types. The system displays only the labels to which values are assigned.

```
┌─────────────────────────────────────────────────────────────────────┐
│ Cardiology Report              Hospital Name Date:   /    /   /       │
│ Patient Name  Patient ID                                             │
│ BP(SYS/DIA):  mmHg  Height:  cm  Weight:  kg  BSA:  m²               │
│                                                                       │
│    Indication    ┌─────────────────────────────────────────────┐     │
│                  └─────────────────────────────────────────────┘     │
│                                                                       │
│  ◉ PISA(MR)                          O  Mitral Valve                  │
│                                                                       │
│  Radius          xy.z    mm      MV E pt        x.xx    m/s           │
│  Aliasing Vel    *ab.c   m/s     MV A pt        x.xx    m/s           │
│                                  IVRT           xxx     ms            │
│                                  A duration     xxx     ms            │
│                                  E duration     xxx     ms            │
│                                  E/A            x.xx                  │
│                                  A/E            x.xx                  │
│                                                                       │
│ ┌────────┐                                                            │
│ │Comments│ ┌──────────────────────────────────────────────┐          │
│ └────────┘ └──────────────────────────────────────────────┘          │
│                                                                       │
│ Page  1/2   Prev   Next   Referring Physician   Send Report  Worksheet Return │
└─────────────────────────────────────────────────────────────────────┘
```

To access the Cardiology Report:

1. During a Cardiac exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

    The system displays the first page of the Cardiology Report.

2. To access a different report page, roll the trackball to position the pointer on **Prev** or **Next** at the bottom of the report and then press the **SET** key.

3. To redisplay the image screen, press the **ESC** key or roll the trackball to position the pointer on **Return** at the bottom of the report and then press the **SET** key.

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the *Comments* field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

    A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

    The system places the phrase in the **Comments** field of the report.

    Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

    The system removes the list of phrases from the screen.

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

- Press a documentation control on the control panel that is configured for the print function.

  The system transfers the information displayed on-screen to the specified documentation device.

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

- Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

  The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

- To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

B7 Emergency Medicine Measurements and Calculations

Emergency Medicine Measurements and Calculations

The Emergency Medicine (EM) package includes measurements, calculations, and patient reports for assessing:

- Dimensions of abdominal organs: Gall bladder wall, bile duct, and aorta
- Cardiac function: End-diastolic and end-systolic volumes and the derived ejection fraction
- Fetal Growth: Gestational sac, crown-rump length, and biparietal diameter
- Bladder dimensions for the transverse and sagittal planes

Customizing Emergency Medicine (EM) Measurements and Reports

Use the system presets to customize the EM exam type.

Options for Exam Configuration Default Settings

- Select the system response when the **FREEZE** key is pressed
- Create or edit the Pictogram List
- Create or edit the Text Annotation List

Options for Measurements and Reports (M & R)

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display for each mode, and the order in which they display
- Restrict the display of Measured Results to measured values or display all labels with or without measurement values
- Include or exclude physician identification in the patient report
- Define the Comments Library for the patient report
- Select the formula for determining a Bladder Volume
- Select the author for use with the menstrual age parameters.

System Reference

System Presets   Ch 3

Emergency Medicine (EM) ▪ Measurement Menu

System-defined measurement labels for the active measurement type display in the Measurement Menu. When a measured result is assigned to a label, the label and value display in the associated section of the patient report.

The system performs 2D-mode calculations when you complete the required measurements and assigns calculation labels to the results. Calculated results display in the Measured Results section of the screen and are transferred to the associated section of the patient report.

Emergency Medicine (EM) ▪ 2D-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
GB Wall thk	Gall bladder wall thickness	Distance
Bile duct	Bile duct	Distance
Aorta	Aorta	Distance
EDV	Left Ventricular End Diastolic Volume	1 Plane Disk
ESV	Left Ventricular End Systolic Volume	1 Plane Disk
GS	Gestational Sac, maximum thickness	Distance
CRL	Crown Rump Length	Distance
BPD	Biparietal Diameter	Distance
Bl Trans D	Bladder, Transverse Depth	Distance
Bl Trans W	Bladder, Transverse Width	Distance
Bl Sag D	Bladder, Sagittal Depth	Distance
Bl Sag L	Bladder, Sagittal Length	Distance

Emergency Medicine (EM) ▪ 2D-Mode Calculation Labels

Calculation Label	Description	Requirements	Units
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV)÷EDV].	EDV ESV	%
Bladder V	***Bladder Volume*** is calculated from transverse or sagittal bladder measurements, or from measured results in both planes.		mL
	Transverse 1 Plane Volume: (π x TD x TW x TW) / 6	Transverse Diameter Transverse Width	
	Sagittal 1 Plane Volume: (π x SD x SL x SL) / 6	Sagittal Diameter Sagittal Length	
	Combined 2 Plane Volume:		
	(π x (TD+SD)/2 x TW x SL / 6 or (π x TD x TW x SL) / 6 or (π x SD x TW x SL) / 6		

Determining a Left Ventricular End-Diastolic or End-Systolic Volume

When a volume measurement label is selected in the Measurement Menu, the default volume measurement method displays at the top, above the name of the measurement type. The EM exam uses the one-plane disk volume measurement method.

To determine an EDV or ESV:

1. During an **EM** exam, acquire and freeze a 2D-mode image.

2. Press the **CINE** key to activate CINE playback.

3. Roll the trackball to view an end systolic or end diastolic frame.

4. Activate the measurement function.

    The Measurement Menu displays measurement labels.

5. Roll the trackball to select **EDV** or **ESV** in the Measurement Menu and then press the **SET** key.

    The system places a measurement marker on the image, activates the **1Pl Disk** volume measurement method, and displays the area (**A**), circumference (**C**), diameter (**D**), and volume (**V**) of the structure in the Measured Results.

6. Roll the trackball to position the measurement marker to begin the volume trace and then press the **SET** key.

    The system anchors the marker.

7. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.

8. To complete the trace, press the **SET** key.

    The system connects the beginning and end points of the trace and displays a line representing the long axis.

9. Roll the trackball to position the endpoint of the long axis and then press the **SET** key.

    The system displays the volume in the Measured Results and assigns the volume value to the measurement label.

Emergency Medicine (EM) ▪ M-Mode Calculation Labels

The system performs M-mode calculations when you complete the required measurements. The resulting values display in the Measured Results and are automatically transferred to the associated section of the patient report.

[2] Instructions for Use

Measuring Fetal
Heart Rate   Ch B2

Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One cardiac cycle in M-mode

Emergency Medicine (EM) Patient Report

The system transfers the labeled measurements and calculations from each measurement or derived calculation into the corresponding section of data, or **tab**, of the Emergency Medicine (EM) Report. Information from the Patient Data form displays in the top two lines of the patient report.

EM Report Data (Tabs)

The system displays an asterisk next to the name of each tab that contains report data. Report data includes descriptive fields and the measured and calculated results. Report tabs for the EM exam include:

- FAST (Focused Abdominal Sonography in Trauma)
- Aorta
- Gallbladder
- Renal
- Obstetric
- Cardiac
- Bladder
- DVT (Deep Vein Thrombosis)

FAST Data

FAST is Focused Abdominal Sonography in Trauma. The data in this section of the report can be used during an ultrasound examination to determine whether fluid has accumulated in the abdominal cavity.

Description of Unique Report Fields

Field	Description	Selections
Morison's pouch	Anterior surface of the hepar and the right kidney.	**Negative fluid**
		Positive fluid
		Not imaged
Splenorenal view	Splenorenal	**Negative fluid**
		Positive fluid
		Not imaged
Suprapubic view	Bladder	**Negative fluid**
		Positive fluid
		Not imaged
Cardiac view	Heart	**Subcostal view**
		Parasternal view
		Not imaged
Pericardial effusion	Pericardial effusion	**None**
		Physiologic fluid/ epicardial fat
		Small effusion
		Moderate effusion
		Large effusion
Right chest	Right chest	**Pleural fluid**
		No pleural fluid
		Not imaged
		Lung sliding/ comet tail present
		Lung sliding/ comet tail absent
Left chest	Left chest	**Pleural fluid**
		No pleural fluid
		Not imaged
		Lung sliding/ comet tail present
		Lung sliding/ comet tail absent

Aorta Data

Description of Unique Report Fields

Field	Description
Imaged transversely	Check box to indicate the orientation of image.
Imaged longitudinally	Check box to indicate the orientation of image.
Aorta	Measured result

Gallbladder

Description of Unique Report Fields

Note: If a measurement has been completed or the Description has been edited, the system inserts an asterisk mark (*).

Field	Description
Imaged transversely	Check box to indicate the orientation of image.
Imaged sagitally	Check box to indicate the orientation of image.
Gallstones present **Gallstones absent**	Check box to indicate the presence or the absence of gallstones.
Wall thickening present **Wall thickening absent**	Check box to indicate the presence or absence of thickening of the gallbladder wall.
Wall thickness	Measured result
Sonographic Murphy's present **Sonographic Murphy's absent**	Check box to indicate the presence or absence of tenderness above the gallbladder.
Pericholecystic fluid present **Pericholecystic fluid absent**	Check box to indicate the presence or the absence of pericholecystic fluid.
Common bile duct measured	Measured result
Common bile duct not imaged	Check box to indicate the bile duct was not imaged.

Renal Data

Description of Unique Report Fields

Field	Description	Selections
Right kidney	Check box to indicate the orientation of the image	**Imaged coronally**
		Imaged transversely
Hydronephrosis	Hydronephrosis of right kidney	**None**
		Mild
		Moderate
		Severe
Left kidney	Check box to indicate the orientation of the image	**Imaged coronally**
		Imaged transversely
Hydronephrosis	Hydronephrosis of left kidney	**None**
		Mild
		Moderate
		Severe

Obstetric

Description of Unique Report Fields

Note: If a measurement has been completed or the Description has been edited, the system inserts an asterisk mark (*) **except when any of LMP (IVF), Clinical MA, and/or Clinical EDC is edited.**

Field	Description	Selections
MAFP	Maternal Alpha-Fetoprotein (Level)	Transferred from the Patient Data form
Gravida	Gravida (the number of times of pregnancy)	Transferred from the Patient Data form
Para	Para (the number of times of live birth)	Transferred from the Patient Data form
AB	Abortion (the number of times of abortion)	Transferred from the Patient Data form
Ectopic	Ectopic pregnancy (the number of times of pregnancy)	Transferred from the Patient Data form
LMP	Last menstrual period	Date transferred from the Patient Data form or selected from the drop-down calendar
	When LMP is calculated from Clinical MA or Clinical EDC, the system inserts the mark ** at the beginning of the indication.	
	In-vitro Fertilization Data (IVF) may be used instead of LMP.	
	IVF = LMP + 14 Days	
	When IVF is calculated from Clinical MA or Clinical EDC, the system inserts the mark ** at the beginning of the indication.	
Clinical MA	Clinical Menstrual Age Clinical MA = StudyDate - LMP	Week + Day
Clinical EDC	Clinical Estimated Data of Confinement Clinical EDC = LMP + 280 Days	Date transferred from the Patient Data form or selected from the drop-down calendar

Field	Description	Selections
Measurement	Displays the selected reference author and estimated menstrual age based on measured results for: BPD GS CRL Displays measured results for: FHR	---
Uterus imaged transversely	Check box to indicate the orientation of the image of the uterus.	---
Uterus imaged longitudinally	Check box to indicate the orientation of the image of the uterus.	---
Intrauterine gestational sac present	Check box to indicate the presence of the intrauterine gestational sac.	---
Yolk sac present	Check box to indicate the presence of the yolk sac.	---
Fetal pole present	Check box to indicate the presence of the fetal pole.	---
Cardiac flicker present	Check box to indicate the presence of cardiac flicker.	---
Fetal motion present	Check box to indicate the presence of fetal motion.	---
Interpretation	Interpretation	**Intrauterine pregnancy** **Live intrauterine pregnancy** **No definitive uterine pregnancy**
Fluid in cul-de-sac	Fluid in cul-de-sac	**None** **Physiologic** **Small** **Moderate** **Large**

Cardiac Data

Description of Unique Report Fields

Note: If a measurement has been completed or the Description has been edited, the system inserts an asterisk mark (*).

Field	Description	Selections
Subcostal view	Check box to indicate the orientation of the image.	---
Parasternal view	Check box to indicate the orientation of the image.	---
Apical view	Check box to indicate the orientation of the image.	---
Pericardial effusion	Pericardial effusion	**None** **Physiologic fluid/ epicardial fat** **Small effusion** **Moderate effusion** **Large effusion**
LV Function	Left ventricular function	**Good(EF > 50%)** **Moderate(EF 30-50%)** **Poor(EF < 30%)**
EF	Ejection Fraction	Calculation results based on EDV and ESV measurements

Bladder

Description of Unique Report Fields

Note: If a measurement has been completed, the system inserts an asterisk mark (*).

Field	Description	Selections
Imaged transversely	Check box to indicate the orientation of image.	---
Depth	Measured results	---
Width	Measured results	---
Imaged sagitally	Check box to indicate the orientation of image.	---
Depth	Measured results	---
Length	Measured results	---
Volume	Calculated results based on transverse and/or sagittal plane measurements and the labeled measurements used to calculate the volume.	**Trans D** (Transverse Depth) **Trans W** (Transverse Width) **Sag D** (Sagittal Depth) **Sag L** (Sagittal Length)

DVT (Deep Vein Thrombosis)

Description of Unique Report Fields

Field	Description	Selections
Leg imaged	Leg Imaged	**Right** **Left**
CFV	Common Femoral Vein	**Compressible** **Non-compressible** **Not imaged**
SFV	Superficial Femoral Veins	**Compressible** **Non-compressible** **Not imaged**
Pop V.	Popliteal Vein	**Compressible** **Non-compressible** **Not visualized**

Viewing and Using the Report

Accessing the Report and Report Sections (Tabs)

To access the Report:

1. During an **EM** exam, press the **F2** key on the keyboard or roll the trackball to highlight **Report** in the Measurement Menu and then press the **SET** key.

    The system displays the first tab of the Report.

2. To access a different report tab, roll the trackball to position the pointer on the name of the tab and then press the **SET** key.

3. To redisplay the image screen, press the **ESC** key or roll the trackball to position the pointer on **Return** at the bottom of the report and then press the **SET** key.

Selecting a Check Box

To select a check box:

1. Access the patient report.

2. Roll the trackball to position the pointer on a check box and then press the **SET** key.

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Note: If the report has more than one page, you must access the page containing the ***Comments*** field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report.

2. Enter text using the keyboard.

Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

Note: Use the system presets to pre-define comments for each exam type.

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

   A list of available phrases displays on the screen.

2. Roll the trackball to highlight a phrase and then press the **SET** key.

   The system places the phrase in the **Comments** field of the report.

   Note: When adding new comments to existing comments, roll the trackball to position the pointer at the end of the existing text in the **Comments** field and then press the **SET** key.

3. Continue entering phrases. When finished, press the **ESC** key on the control panel to exit.

   The system removes the list of phrases from the screen.

System Reference

System Presets   Ch 3

📃

F4

M&R
▶ Measurement and
  Report Preset
▶▶ Comments Library
  for Report

Printing a Patient Report

For exam types with a patient report, the system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report. You can print the report to an optionally installed video printer using the control panel, or you can transfer the report to the USB or RS-232C port by selecting the **Send Report** button on the report page.

Video Printer (On-board)

Use the system presets to assign a documentation control to the printing function.

To print the report to an on-board video printer:

- Press a documentation control on the control panel that is configured for the print function.

  The system transfers the information displayed on-screen to the specified documentation device.

Peripheral Printer (Off-board)

Use the system presets to assign functionality to the serial port or to a USB port as the destination for data sent through the system.

To send data to a USB port or the RS-232C port:

- Roll the trackball to the **Send Report** button on the report and then press the **SET** key on the control panel.

  The **Send Report** button is changed to the **Cancel** button.

To cancel the Send Report command:

- To interrupt immediately, roll the trackball to the **Cancel** button and then press the **SET** key.

C1 Transducer Accessories

Transducer Accessories

Attachment procedures for the following accessories are presented in this chapter or are shipped separately with the device. Accessories are arranged by transducer type in the following table:

[1] Instructions for Use

Cleaning and Care   Ch 2

Accessory	Curved Array	Linear Array	Mechanical Sector
Transducer Sheath	All	All	All
Gel Pad		7.5L70 L10-5 5.0L45	
Universal Needle Guide S	C6-2 5.0C50+	7.5L70 L10-5 5.0L45	
CH4-1 Needle Guide Bracket Kit	CH5-2		
6.5EV13 Needle Guide Bracket Kit	EV9-4		
BE9-4 Disposable Needle Guide Kit	BE9-4		
BE9-4 Stainless Steel Needle Guide Kit	BE9-4		
EC9-4 Disposable Needle Guide Kit	EC9-4		
EC9-4 Stainless Steel Needle Guide Kit	EC9-4		

Transducer Sheaths

Siemens makes every effort to manufacture safe and effective transducers. You must take all necessary precautions to eliminate the possibility of exposing patients, operators, or third parties to hazardous or infectious materials. These precautions should be considered in the use of any application that may indicate the need for such care, and during endocavity or intraoperative scanning; during biopsy or puncture procedures; or when scanning patients with open wounds.

General Information ▪ Sheaths

⚠ **WARNING:** There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Health care professionals are advised to identify latex-sensitive patients and to be prepared to treat allergic reactions promptly. For additional information in the U.S.A., refer to FDA Medical Alert MDA91-1.

⚠ **WARNING:** Only a sterile transducer sheath provides the sterile barrier required for surgical or puncture procedures. To ensure sterility of a procedure, always place a sterile sheath on a transducer as transducers cannot be sterilized using hot steam, cold gas, or Ethylene Oxide (ETO) methods.

Transducer sheaths are single-use items used to ensure proper acoustic coupling and provide a prophylactic barrier for the intended ultrasound application. Sheaths are available for all transducers. Siemens recommends the use of market-cleared transducer sheaths.

Application ▪ Sheaths

Step-by-step instructions are provided for both non-sterile and sterile procedures.

To place the transducer in a sheath for non-sterile use:

Before applying any coupling agent (gel) to the sheath, remove any powder in the sheath by rinsing with water.

1. Remove the packaging and unfold the transducer sheath.

2. Apply a water-based coupling agent (gel) to the inside of the sheath and onto the face of the transducer.

3. Hold the transducer by the cable relief and unroll the sheath onto the transducer.

4. Pull the transducer sheath tightly over the face of the transducer to remove wrinkles.

5. Secure the sheath to the transducer housing or cable relief with the adhesive tapes or elastic bands provided.
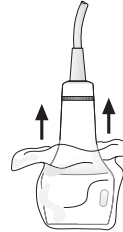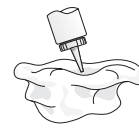
To place the transducer in a sheath for sterile use:

Before applying any sterile coupling agent (gel) to the sheath, remove any powder in the sheath by rinsing with sterile water.

1. Using sterile technique, remove the packaging and unfold the transducer sheath.

2. Taking care not to contaminate the sheath, apply a sterile water-based coupling agent (gel) to the inside of the sheath and onto the face of the transducer.

3. Using sterile technique, hold the transducer by the cable relief and unroll the sheath onto the transducer and cable.

4. Pull the transducer sheath tightly over the face of the transducer to remove wrinkles.

5. Secure the sheath to the transducer cable with the adhesive tapes or elastic bands provided.

⚠ **WARNING:** After placing the sheath over the transducer, visually inspect the sheath to ensure there are no defects. Do not use the sheath if it has any holes or tears.

Disposal ▪ Sheaths

While wearing protective gloves, remove the transducer sheath from the transducer and dispose of it according to medical regulations for biohazardous waste.

Gel Pad

The gel pad is a disposable bacteriostatic standoff. It is used when superficial imaging requires an appropriate standoff for utilizing the focal zone of the transducer. The gel pad provides a fixed distance between the transducer face and the body surface.

⚠ **WARNING:** Ultrasound energy is transmitted more efficiently through the gel pad than through tissue. When using a standoff device of any kind, for example a waterpath or gel pad, the actual mechanical and thermal indices, MI and/or TI, may be higher than indicated in the output display on the system.

Preparation for use

Before use, examine the gel pad for any material flaws. Any product showing flaws should not be used.

Disposal ▪ Gel Pad

While wearing protective gloves, remove the gel pad from the transducer and dispose of it according to medical regulations for biohazardous waste.

Needle Guide Brackets

⚠ **WARNING:** Percutaneous procedures always involve heightened risk to the patient and to the operator handling biopsy needle guides. Clinicians using Siemens recommended biopsy devices under ultrasound guidance should be trained and must observe proper needle insertion sequencing with the needle guide in order to avoid undue discomfort and unnecessary risk and injury to the patient.

BE9-4 Disposable Needle Guide Kit

Refer to the in-box instructions for attachment and care procedures.

BE9-4 Stainless Steel Needle Guide Kit

Refer to the in-box instructions for attachment and care procedures, including cleaning and sterilization.

EC9-4 Disposable Needle Guide Kit

Refer to the in-box instructions for attachment and care procedures.

EC9-4 Stainless Steel Needle Guide Kit

Refer to the in-box instructions for attachment and care procedures, including cleaning and sterilization.

CH4-1 Needle Guide Bracket Kit

Refer to the in-box instructions for attachment and care procedures,

Note: The CH5-2 transducer has been designed to function properly with the CH4-1 Needle Guide Bracket Kit.

Universal Needle Guide S

The Universal Needle Guide is a stainless steel transducer accessory used for biopsy and needle puncture procedures.

The Universal Needle Guide S consists of a needle bracket and three (3) needle caps. The needle caps are designed for quick release.

Components of the Universal Needle Guide S

needle bracket   *needle cap*
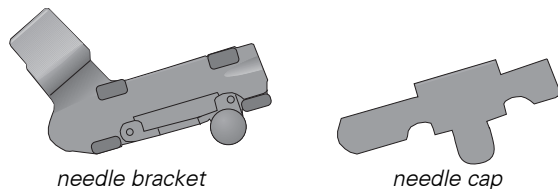
The needle bracket and needle cap have a single angle. When the needle cap is attached to the bracket, a needle channel is created. This channel secures needles in the needle guide.

The needle caps are labeled with the needle size. Needle caps are provided for the following needle sizes:

- 0.9 mm (20 gauge)
- 1.2 mm (18 gauge)
- 1.8 mm (15 gauge)

Note: The Universal Needle Guide S supports *only* the needle sizes in the above list.

Preparation for Use ▪ Universal Needle Guide

⚠ **WARNING:** Do not attempt to use the needle guide until you have read the following instructions. The needle guide should only be used after proper training and after verifying the path of the needle.

⚠ **WARNING:** The needle guide kit is packaged non-sterile. Sterilize these components prior to the first use.

⚠ **WARNING:** Ensure that the needle guide components are properly cleaned and sterilized before each use to avoid possible patient contamination.

⚠ **WARNING:** Before attaching the needle guide to the transducer, place the transducer in a sterile transducer sheath.

⚠ **WARNING:** There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Health care professionals are advised to identify latex-sensitive patients and to be prepared to treat allergic reactions promptly. For additional information in the U.S.A., refer to FDA Medical Alert MDA91-1.

⚠ **Caution:** Use only a water-based ultrasound coupling agent (gel) with this kit. Petroleum- or mineral oil-based materials can harm the transducer.

[2] Instructions for Use

Needle Path
  Verification   Ch A6

[1] Instructions for Use

Cleaning and Care   Ch 2
Sterilization   Ch 2

To attach the needle cap to the needle bracket:

1. Place a sterile transducer sheath over the transducer.

2. Select the needle cap that matches the size of the needle to be used in the procedure. The needle size is marked on each needle cap.

3. Place the needle cap into the raised edge on the needle bracket, and then snap the needle cap onto the bracket. This secures the cap to the bracket and forms the needle channel.
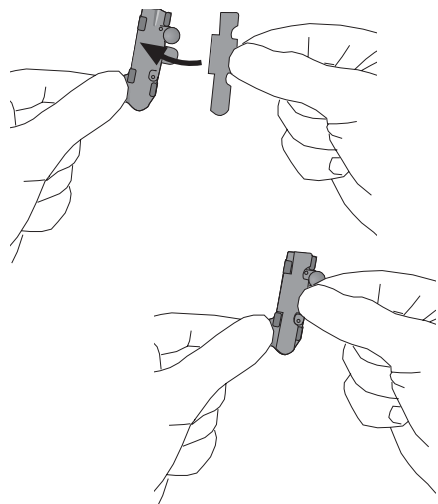
Attaching the needle cap to the needle bracket.

To attach the needle guide to the transducer:

After the needle cap is attached to the needle bracket, attach the needle guide to the transducer.

Using sterile technique:

1. Loosen the thumb screw on the needle guide.

   Attach the needle guide to the grooves on the side of the transducer housing.

   Note: For illustration purposes only, the transducer is shown without a transducer sheath. Always place a sterile transducer sheath over the transducer.
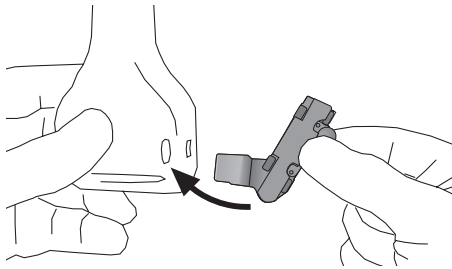
Attaching the needle guide to the transducer.

2. Gently tighten the thumb screw to firmly secure the needle guide.

⚠ **Caution:** Excessive force could harm the transducer.

3. Insert the needle into the channel on the needle guide.

   The needle must be the correct size for the needle guide.

4. Before performing any patient procedure, verify the needle path.

[2] Instructions for Use

Detachment Procedure ▪ Universal Needle Guide S

Before you remove the needle guide from the transducer, remove
the needle cap from the needle bracket.

To remove the needle cap from the needle bracket:

1. Push down with the thumb and up with the index finger on the tabs
   to release the needle cap.

2. Pull the needle cap away from the bracket.
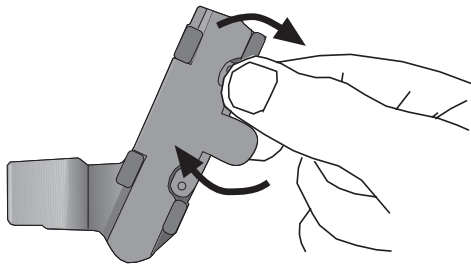
Detaching the needle cap from the needle bracket.

To remove the needle guide from the transducer:

1. Loosen the thumb screw on the needle guide.

2. Lift the needle guide up and away from the transducer.

6.5EV13 Needle Guide Bracket Kit

The 6.5EV13 Needle Guide Bracket Kit consists of a needle guide and two cleaning brushes. You can use the needle guide with needle sizes ranging from 16 to 22 gauge (1.60 mm to 0.7 mm).

Example of the 6.5EV13 Needle Guide.

Note: The EV9-4 transducer has been designed to function properly with the 6.5EV13 Needle Guide Bracket Kit.

Preparation for Use ▪ 6.5EV13 Needle Guide Bracket Kit

⚠ **WARNING:** Do not attempt to use the Needle Guide Bracket Kit until you have read the following instructions. The needle guide should only be used after proper training and after verifying the path of the needle.

⚠ **WARNING:** The needle guide is packaged non-sterile. Sterilize this product prior to its first use.

⚠ **WARNING:** Ensure that the needle guide is properly cleaned and sterilized before each use to avoid possible patient contamination.

⚠ **WARNING:** Before attaching the needle guide to the transducer, place the transducer in a sterile transducer sheath.

⚠ **WARNING:** There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Health care professionals are advised to identify latex-sensitive patients and be prepared to treat allergic reactions promptly. For additional information in the U.S.A., refer to FDA Medical Alert MDA91-1.

⚠ **Caution:** Use only a water-based ultrasound coupling agent (gel) with this kit. Petroleum- or mineral oil-based materials can harm the transducer.

To attach the needle guide to the transducer:

⚠ **WARNING:** Care must be taken to ensure that the needle guide is properly positioned. When properly positioned, the bracket will cover the colored ring on the transducer handle and the hook will be firmly against the transducer tip.
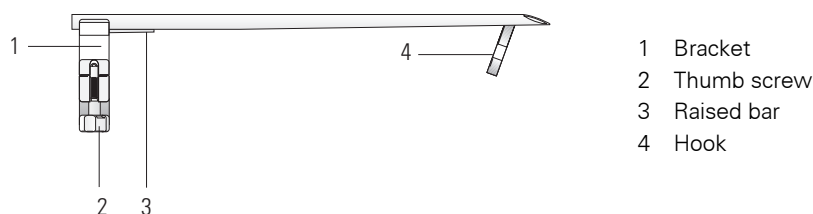
1. Place a sterile transducer sheath over the transducer.

   To ensure an accurate scan, there should not be any air bubbles or wrinkles between the transducer face and the transducer sheath.

2. Loosen the thumb screw in the needle guide bracket.

   1   Bracket
   2   Thumb screw
   3   Raised bar
   4   Hook

3. Lift up the thumb screw to open the bracket.

   Notice the raised bar on the inside of the bracket end of the needle guide. In step 4, this bar must fit in the notch on the colored ring on the transducer handle.

4. Place the hook over the middle of the transducer's shaft and then slide it up the length of the shaft.
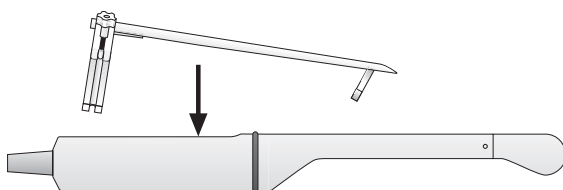
   Note: For illustration purposes only, the transducer is shown without a transducer sheath. Always place a sterile transducer sheath over the transducer.

   When properly positioned, the bracket must cover the colored ring and the raised bar fits in the notch.
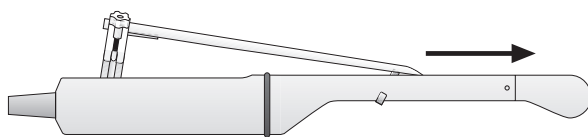
5. Close the bracket, reposition and tighten the thumb screw.
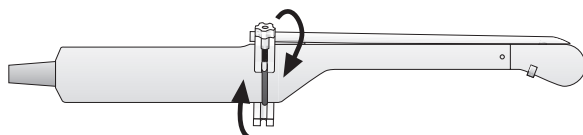
6. Before performing any patient procedure, verify the needle path.

C2 Specialty Transducers

BE9-4 Biplane Transducer

⚠ **WARNING:** Before attempting to use endocavity transducers, you should be trained in ultrasonography and endocavity scanning techniques, and you should be thoroughly familiar with the safe operation of the ultrasound imaging system.

The BE9-4 transducer is a bi-plane endocavity transducer for prostate and endovaginal imaging. A micro-touch toggle switch is integrated into the transducer handle for changing the active scan plan (sagittal or transverse) of the transducer.

The ultrasound system identifies the active scan plane of the transducer with a graphical icon (a scan plane symbol) on the image screen. The indentation on the handle of the transducer provides you with an orientation to the echo in the image.

1   Micro-touch toggle switch
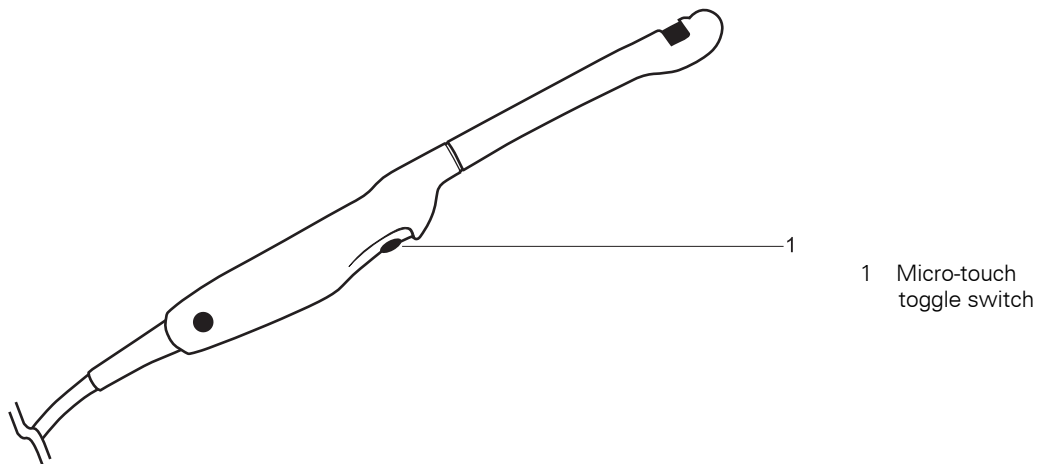
Location of micro-touch toggle switch on BE9-4 transducer handle.
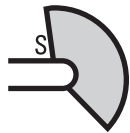
Example of scan plane symbol for the sagittal (S) plane.
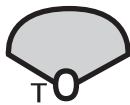
Example of scan plane symbol for the transverse (T) plane.

Preparation for Use

⚠ **WARNING:** Ensure the transducer is properly cleaned and high-level disinfected before use to avoid possible patient contamination.

Using a Protective Sheath

⚠ **WARNING:** There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Health care professionals are advised to identify latex-sensitive patients and be prepared to treat allergic reactions promptly. For additional information, refer to FDA Medical Alert MDA91-1.

For patient and operator safety, cover the transducer with a protective sheath at all times during use.

Connecting and Disconnecting Transducers ▪ BE9-4

Connect a specialty array transducer, such as the BE9-4 transducer, to the specialty array transducer port.

⚠ **Caution:** To avoid possible equipment damage, you must freeze the system before connecting or disconnecting a transducer.

Note: When transducer connectors are being attached to or disconnected from the system, resistance may be encountered due to the special shielding material inside the connectors. This is normal for these transducers.
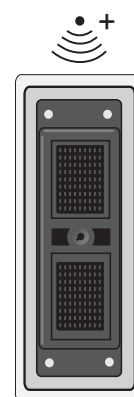
Specialty array transducer port.

To connect an array or a specialty array transducer:

Note: You can connect the BE9-4 transducer to the specialty array port only. The system displays a message should you attempt to connect the transducer to another port.

1. Hold the transducer connector with the cable extending upward from the connector.

2. Insert the connector pins into the system port. Adjust the connector until you can turn the lever on the transducer connector clockwise to lock it in position.

   This secures the connector in position and ensures the best possible contact.

3. Place the transducer in the transducer holder and drape the cable through the cable hangers.

To disconnect an array or specialty array transducer:

⚠ **Caution:** To avoid damaging the transducer cable, do not pull on the cable to disconnect the transducer. Use the following instructions.

1. Turn the lock on the connector housing counterclockwise until it unlocks.

2. Firmly grasp the transducer connector and carefully remove it from the system port.

3. Store each transducer in its protective carrying case.
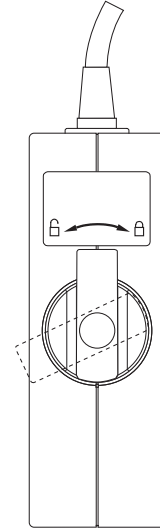
Locked and unlocked positions of the connector.

Activating the BE9-4 Transducer

Although multiple transducers can be connected to the ultrasound system, only one transducer can be active. Use the **TRANSDUCER** key on the control panel to view an LCD listing of transducers currently connected to the system.

The names of the transducers display on the LCD, with the active transducer highlighted.

To activate a transducer connected to the system:

1. Press the **TRANSDUCER** key located on the control panel.

    The system displays the names of the available transducers and options on the LCD.

    Use the system presets to select the transducer port that will be active at system power-on.

2. Press the LCD key corresponding to the required transducer.

    The system highlights the name of the selected transducer on the LCD and activates your selection.

▤

F4

Boot Up
▶ Transducer Port Active
   On Boot Up

Imaging with the BE9-4 Transducer

The BE9-4 transducer supports all of the functions and controls that are available in 2D-mode, M-mode, Color, and Doppler. The BE9-4 also supports SieScape panoramic imaging.

When you have acquired an image, you can change the orientation of the image, make measurements and calculations, annotate with pictograms or text, or perform a biopsy or puncture procedure.

Changing the Transmit Frequency

- Push the **MULTIHERTZ** control on the control panel up to increase the frequency or down to decrease the frequency.

  The system uses the next available frequency for imaging. The system displays the name of the active transducer and the operating frequency in the upper left of the image screen.

Changing the Image Orientation

The following illustrations indicate how the displayed image is oriented when you use **ROTATE**. Each press of **ROTATE** rotates the image 90° clockwise.

                90°   180°   270°
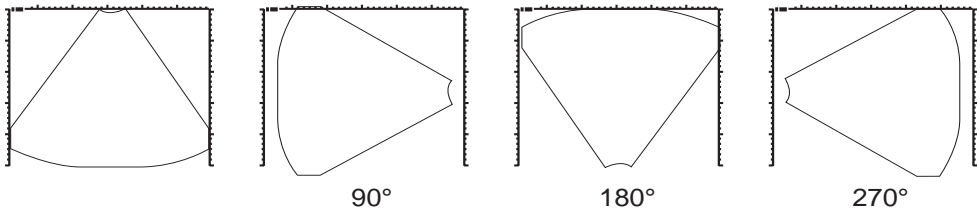
Changing the Scan Plane

- To change the scan plane, press the micro-touch toggle switch on the transducer's handle. This control changes the transducer scan plane (sagittal or transverse).

Adjusting the Field of View

The maximum field of view in the sagittal scan plane or in the transverse scan plane is 162°.

To adjust the field of view:

1. Press **⊙FOV/POS** on the 2D-mode LCD to select **FOV.**

2. Roll the trackball to the left to decrease or to the right to increase the sector angle of the image.

3. To reposition the resized 2D-mode image, press the **⊙FOV/POS** selection a second time to select **POS**.

4. Roll the trackball to the right or to the left to reposition the field of view.

5. To exit, press the **⊙FOV/POS** selection until the **OFF** setting displays.

Biopsy or Puncture Procedures

When you select the Biopsy function during 2D-mode imaging, the system displays biopsy guidelines for the sagittal plane or a reference line for the transverse plane. The reference line aids in locating the target.

[2] Instructions for Use

Biopsy   Ch A6

Technical Data ▪ BE9-4 Biplane Transducer

Transducer type:	Curved array, bi-plane endocavity (sagittal and transverse)
Elements:	128 (each array)
2D-mode transmit frequencies:	4.2 MHz, 6.5 MHz, 9.0 MHz
Doppler and color transmit frequencies:	5.2 MHz, 7.0 MHz
Operating modes:	2D-mode, Dual, Split (B+B), 4B-mode, M-mode, 2D/M-mode, 2D-mode with color, Doppler, 2D-mode with Doppler
Maximum displayable field of view:	Sagittal plane: 162° Transverse plane: 162°
Radius of curvature:	9 mm
Orientation:	On-screen graphical icons indicate sagittal or transverse scan plane
Cable length:	2.2m
Operating environment:	+10°C to +40°C Operation up to 3,000m
Storage:	-40°C to +60°C Storage up to 3,000m
Humidity:	Up to 80% relative humidity
Weight:	250g (without cable)
Degree of protection against electrical shock:	BF
Degree of protection against ingress of fluids:	IPX8

[1] Instructions for Use

Environmental
    Requirements   Ch 6